CHIROPODIAL
ORTHOPÆDICS

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BY

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FOREWORD BY

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FOREWORD

MR CHARLESWORTH has for many years been a distinguished exponent of the difficult art of relieving the discomfort and disablement resulting from deformities of the feet by the use of mechanical appliances designed for each individual case He has now given a clear practical description of the many original devices which he has evolved after a prolonged trial It is fitting that Mr Charlesworth's techniques should now reach a wider public, and this monograph will, I am sure, be of the greatest assistance to Orthopædic Surgeons, Physiotherapists and Chiropodists

HARRY PLATT

October 1951

PREFACE

In presenting this volume I have endeavoured to place at the disposal of the reader the results of my investigations, experiments and clinical tests in a field of work which is attracting the interest of surgeons and chiropodists alike in ever increasing numbers Whilst the title of the book, *Chiropodial Orthopædics*, has been adopted for reasons explained by me elsewhere in the volume, it does not necessarily follow that it will be the term ultimately applied to this work

The various types of appliances have, as far as possible, been grouped according to the processing techniques Many of the simple devices outlined in this book will be found particularly applicable in School Health Service Clinics. I have in mind such appliances as toe props, traction slings and cork wedges The more advanced form of latex therapy, such as moccasin appliances, etc , has provided some most encouraging results in the treatment of gross deformities and certain post-operative cases.

Corrective surgical insoles and most rest appliances can be satisfactorily accommodated in normal footwear of a reasonable type, but it will be appreciated that the extra bulk involved in some cushion insoles frequently necessitates the provision of special shoes to accommodate them As these, however, are usually made for chronic cases exhibiting painful pressure symptoms and gross deformities of the toes, the need for special shoes for these appliances cannot be regarded as unreasonable.

Whilst the weight of evidence in support of chiropodial orthopædics as a new and valuable therapeutic field is rapidly accumulating, the reader should be warned that its application should be as part of a properly co-ordinated system of progressive treatment I have found that many of my most effective appliances have been based on careful observations

and experiments in padding and strapping, during what one may term orthodox chiropodial treatment In such cases the appliances were introduced at a stage in the treatment when their application was likely to be most effective

In conclusion, I cannot let this opportunity pass without expressing my grateful appreciation of the exceptional assistance rendered by Mr Donald Neale, M Ch S , in reading and correcting the original MS , for his helpful co-operation with the publisher, and for offering many valuable suggestions and constructive criticisms To Mr L C Gibbard, M Ch S , for his most careful reading and correcting of galley proofs, assistance in the preparation of the index and many constructive suggestions, and to my personal assistant, Mr Charles Newman, M Ch S , for untiring conscientious assistance in preparing clinical specimens and assisting generally, I offer my sincere thanks I also appreciate the assistance of the British Boot, Shoe, and Allied Trade Research Association, who kindly lent some of their illustrations

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CHAPTER I

INTRODUCTION

IT has become increasingly apparent in recent years that chiropodists generally have felt the necessity for a broader approach to treatment than has been acceptable to the majority of practitioners in the past

The skilful removal of excrescences and the application of protective dressings have undoubtedly resulted in relief of pain and in temporary comfort for the patient. Such treatment, however, is of a palliative nature The use of adhesive felt padding for corrective purposes is limited in its scope and fails in some cases to achieve its full object Corrective padding must be applied regularly over a long period if an appreciable degree of correction is to be hoped for. It will, however, be the experience of most chiropodists, that before the desired result has been achieved, the repeated application of adhesive pads and dressings has had a very deleterious action on the skin, resulting in a plaster dermatitis or maceration

From the point of view of hygiene, felt pads and strapping in prolonged contact with the foot are not desirable The dressings become saturated with perspiration and encrusted with dirt from the shoes Even with the most careful patient, padding frequently tends to become displaced to a degree that considerably reduces its effectiveness

It is, of course, recognised that skilled reduction of callosities and enucleation of corns, accompanied by ingenious padding of painful areas, is a most necessary initial treatment in most cases, but once the preliminary treatment has achieved its object of relieving pain, the chiropodist should be in the position to embark upon a progressive line of treatment envisaging a definite end-result

Many cases are of a chronic character in which the possibility

of a cure is out of the question, or at least very remote, but it is in such cases that ingeniously devised appliances have produced remarkable and even spectacular results In many cases of serious deformity of the foot, both congenital and acquired, the fitting of appliances made on the principles outlined in this volume has resulted in greatly improved stability, with consequent benefit to posture and gait and the progressive elimination of painful pressure symptoms

The term "Chiropodial Orthopædics" is thought to be appropriate, since it is already widely agreed that this work is essentially orthopædic in nature, and because it is specialised to the foot it is expected to develop within the ever-extending scope of the chiropodist

Orthopædic work of this exacting nature must be based upon a sound academic training and built upon a foundation of anatomy, physiology and regional surgery. Appliances made to treat defects in human structures can only be successful if based upon sound anatomical and physiological principles

The practitioner may be tempted to say that he has frequently endeavoured to treat his patients by the fitting of various replaceable devices, bunion shields, metatarsal socks and supports He may point out how frequently the results have proved most disappointing The answer to these observations is that such appliances are usually mass produced to standard patterns

The author does not deny that many useful devices have been produced by the appliance manufacturers A number of simple shields, props, traction slings, and metatarsal appliances have been introduced in recent years which have proved adequate to the needs of many patients Various types of arch supports have been successfully fitted, but in this field the usefulness of mass-produced appliances has proved to be limited Many have required extensive remoulding or other modification by an experienced practitioner

In general, however, if appliances for the treatment of the human foot are to be applied with the best prospects of success, be they either protective shields, rest appliances or corrective

insoles, they must be individual to the patient, made on casts of the patient's feet Only in this way will they fit truly the contours of the feet for which they are made

Appliances of this kind are devised as the result of a careful assessment of the case Their success is dependent upon the skill and sound judgment of the chiropodist in assessing the case, deciding upon the end-result which he hopes to achieve, and his ingenuity in devising an appliance appropriate to this end It is this ability to assess the case and prescribe the appropriate appliance that is the vital factor, distinguishing the professional chiropodist from the mechanic.

Chiropodial Orthopædics covers a wide field It includes not only the devising, processing and fitting of all manner of appliances for defects and deformities of the feet, but it also requires the practitioner to possess a sound knowledge of shoe therapy In many cases the basis of successful treatment is laid by the prescription of appropriate footwear In others it may be necessary to prescribe surgical alterations to shoes as part of a co-ordinated system of progressive treatment

It is encouraging to note that on the occasions when the author has been privileged to lecture and demonstrate on the subject of Chiropodial Orthopædics to orthopædic surgeons and other members of the medical profession, they have been unanimous in expressing the view that this work will supply a long-felt want

The view has been expressed that such appliances supply the answer to the treatment of many minor deformities of the feet, in which surgery is contra-indicated, or not acceptable to the patient Also, in certain cases these appliances enable the patient to benefit more effectively from surgical treatment

Surgeons are particularly impressed by the great accuracy in the fit of appliances processed by these techniques, and endorse the importance of individuality in surgical appliances

It cannot be over-emphasised that appliances of the nature outlined in this volume can also greatly assist physiotherapists in the treatment of their patients It is hoped that in this work a common ground for co-operation between the chiro-

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podial orthopædist and the physiotherapist will have been established In combination, these two important Medical Auxiliary Services can be extended, and can improve their service to humanity as part of the Orthopædic Services under the guidance and direction of the orthopædic surgeons

CHAPTER II

CASTING

IT will be readily appreciated that for most appliances designed to correct defects of the feet or to protect painful prominences, plaster casts provide the only reliable basis upon which to build An accurate replica of a foot, or part of a foot, for which an appliance is to be designed, will enable the chiropodist to produce a device that will embrace the contours accurately In this way the individual characteristics of the human foot are taken into account, with a degree of perfection not possible by any other means As a basis for corrective and palliative appliances, our requirements in the matter of casts will be very considerable We may require a cast of the whole foot, possibly including the ankle for certain corrective devices, whereas for surgical insoles plantar casts are all that is required in most cases Many appliances, however, will require the cast of only a small area of the foot, e g protective shields for bunion, or for calcaneal exostosis, and the smallest casts are those for defects of the lesser toe In taking casts of the toes for protective shields it is important that this should be done with the toe held at the same angle to the foot as it would assume in the patient's normal shoe, the angle being determined by the height of the heel and consequent pitch of the shoe The taking of plantar casts first involves a negative impression which is then filled with plaster of paris to produce the positive cast When possible, it is advisable to use best dental plaster for this work

PLASTER OF PARIS

Plaster of paris has been in use for one purpose or another for over 2,000 years It derives its name from the fact that it is made from a product of gypsum mined in the quarries near Paris

It is one of the most important materials used in orthopædic surgery and is essential to the dental surgeon Of recent years, however, plaster of paris has come to assume an important rôle in the practice of some chiropodists, and there is no doubt that in future years it will be as important in this profession as it is in surgery and dentistry

The manufacture of plaster of paris has improved very greatly during the past few years At one time it was very impure, which caused much trouble in mixing, in obtaining the correct consistence and in rate of hardening

The materials as mined and used in dental plasters are 95 per cent gypsum, the impurities being natural anhydrites, carbonates, rubidium oxide and some silica These impurities have little or no effect on the physical properties of the materials and act only as adulterants

The setting times of plaster are controlled by several factors quality of manufacture, spatulation, plaster-water ratio and by the addition of substances to accelerate the setting

Manufacture

Should soluble anhydrite be present as an impurity in a considerable quantity, a decrease in the setting time of the plaster will result

Spatulation

It may be accepted that, within certain limits, the more thorough the spatulation of the plaster-water mixture, the quicker it will set

Plaster-Water Ratio

The greater the proportion of plaster to water, the shorter will be the setting time

Assimilation

The rate of setting may be speeded up by the addition of common salt, about a teaspoonful to a foot cast will be adequate to speed up the poorer plaster, but the best quality dental plaster as a rule sets with adequate speed to meet the requirements of the chiropodist without the addition of this ingredient

Plaster Mixing

If good casts are to be obtained, it is necessary to acquire the ability to mix the plaster of paris to the correct consistence. Although instructions, either written or verbal, are necessary to convey essential basic information, only diligent practice will induce the required skill

Plaster of paris may be mixed in any suitable receptacle, but a rubber plaster bowl is particularly useful as any surplus of solid plaster can be easily removed after casting, and disposed of in the waste-bin

It is not possible to be exact in the matter of quantities when advising a plaster mixing, owing to the considerable variation in qualities of plaster It should also be noted that atmospheric variation can affect the mixing and setting It will, however, be useful to note that approximately one quart of water will absorb about four pounds of best quality dental plaster, producing a full-bodied cream that will pour freely yet set quickly into a pot-hard cast A little experimenting will enable the practitioner to ascertain the approximate quantities of plaster and water required for each type of cast. If these quantities and other relevant points are noted, a table can be prepared to which reference can be made and much time and material saved in consequence

When plaster is being mixed, one method is to place the water in the bowl first and to sift the plaster gradually into it, the mixture being stirred thoroughly all the time to avoid clotting and lumpiness If stirring is continuous and mixing thorough, the result should be a smooth cream Setting can be speeded up by the addition of a little salt—about one tablespoonful to a quart of mixture

Another method of mixing the plaster is to place the measured amount of water in the bowl, and then to sift in the plaster and allow it to settle to the bottom Plaster is added until the water has taken as much as it can absorb The mixture should be allowed to stand for a few minutes, after which a layer of surplus water will be noted This water should be carefully poured off and the remaining plaster-water content of the bowl briskly spatulated until it assumes the

consistence of cream. As plaster deteriorates quickly in the presence of damp, it should be stored in a metal container with a tight-fitting lid and kept in a dry place

Separating Media

When taking a plaster of paris negative or making a positive cast from a negative mould, a separating medium is necessary

Petroleum jelly is frequently used for this purpose, but care should be taken to ensure that only a thin, even film is applied In the case of a negative mould of plaster, the lubricated surface can be passed through the flame of a spirit lamp or bunsen burner to melt the jelly and spread it evenly

When small partially enclosed areas are to be reached by the lubricant, it is sometimes difficult to achieve this by the use of petroleum jelly In such cases the chiropodist will find a light machine oil to be more suitable The oil may be poured into the mould and swilled round inside it until all surfaces have been reached, after which the surplus oil can be poured away

A thin soap solution is also an excellent separating medium. This is applied by dipping or with a soft brush In this way a fine film will be left on the surface of the mould that will be so slight as to have a negligible effect on the accuracy of the cast Talcum powder is another separating substance which is frequently advocated, but the author favours a light oil or thin film of petroleum jelly

Sodium silicate (water-glass) is a good separator This medium can be painted over the surface of the mould, leaving a fine, smooth surface

It is not necessary to use a separating substance between the skin and dental wax or composition, nor is this necessary when using "Zelex" Although some practitioners use a separating medium in such cases, the writer has not found it necessary when casting with these materials

NEGATIVE IMPRESSIONS

The negative impression supplies the contours of the object to be reproduced in reverse, and is the mould into which the

plaster is poured to produce the positive cast A considerable variety of materials can be used for the taking of negative impressions, particularly impressions of small objects such as toes, joints, etc For the large casts such as a full foot, a plaster negative is sometimes used, but the introduction of plaster of paris bandages as a successful means of negative casting has resulted in a considerable reduction in the popularity of negative casting with loose plaster of paris

Slipper Casting

Casting a foot by plaster of paris bandages is usually referred to as slipper casting The layers of bandage are applied over the foot to form a thin, firm shell When set, this is cut down the dorsum with plaster scissors and removed like a boot or slipper, hence the name which has become associated with this method The slipper casting method is also used for the more shallow foot casts, and it would be appropriate at this stage to mention that a particular make of plaster of paris bandage, "Gypsona," is greatly superior to the old-fashioned plaster of paris bandages made by patting plaster of paris into loose gauze bandages The binding medium in the bandage fixes the plaster firmly in it before washing, does not interfere with the softening when it is immersed in water, and yet assists in retaining it in the texture of the bandage

The Gypsona bandage can also be used to make negative casts of small areas by applying a number of pieces of appropriate size and shape to build up a mould of adequate strength As in slipper casting, this plaster and gauze shell is used as a mould from which the positive cast is made A little red or yellow ochre mixed with the plaster forming the positive cast will assist in distinguishing the cast when the bandage forming the negative is removed

Putty Casting

Plantar casts can be made by the putty casting technique This method, originally introduced by the author, consists of using a slab of plumber's putty into which the sole of the foot

is pressed to provide the plantar impression This impression also acts as the mould into which the plaster is poured in the making of the positive cast.

Dental Composition and Dental Wax

Other useful media for taking impressions of small objects are dental composition and dental wax The lesser toes, individually or collectively, bunions or exostoses, are the most suitable subjects for casting with these materials When cold, the composition is hard and brittle, but softens to the consistence of putty when immersed in hot water It is supplied in cartons containing a number of small slabs about $\frac{1}{4}$ in thickness When softened by immersion in the hot water the material is readily moulded to the contour to be cast, and sets very rapidly into a hard and brittle shell. Dental wax, which is produced in thin sheets approximately $3\frac{1}{2}$ in by $7\frac{1}{2}$ in and packed in cartons of about 50, is a very pleasing, if delicate, medium for toe casting Great care is required in its use as it is fragile and easily distorted

Zelex

An excellent material for taking impressions of small objects is Zelex For small toe casts, etc , where great detail and exactness are required or where the part to be dealt with presents awkward angularities, this medium provides one of the best methods yet found for meeting the chiropodist's requirements Zelex impression composition requires great care in its preparation, but this should not present any serious difficulty as comprehensive instructions are supplied with the materials

METHODS OF MAKING PLASTER CASTS

Plaster of Paris Casts for Foot or Ankle

For the purpose of making casts of this type, a good foundation is a shoe-box lid or similar type of container, as it controls the plaster used for the taking of the plantar impression The leg and foot are prepared by applying a thin coating of

FIG I

Plantar impression

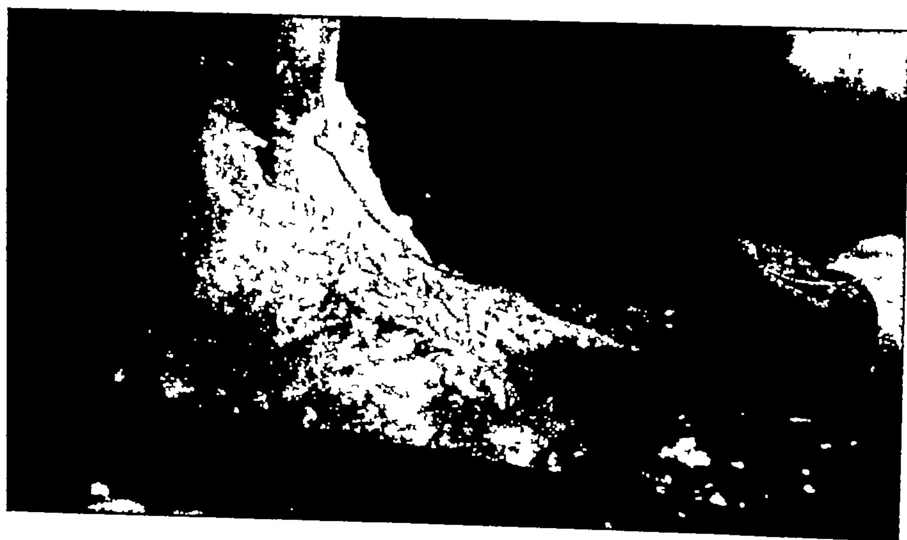


FIG 2

Drawing the string through the plaster just prior to setting

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FIG 3

The complete negative impression



FIG 4

Plaster of paris being poured into the negative cast

petroleum jelly, particular attention being paid to the interdigital spaces A suitable quantity of plaster is now mixed and poured into the receptacle The patient being seated in a comfortable and convenient position, the foot is now placed in the plaster and held still until the plaster is set reasonably firmly (Fig 1), after which it is carefully removed An anklet of twine is placed round the leg just above the intended limit of the plaster Lengths of twine are attached anteriorly and posteriorly to the anklet The anterior length is placed down the dorsum of the foot to extend beyond the toes, whereas the posterior one passes down the back of the leg to the base of the heel with similar surplus If these lengths of twine are gently pressed against the skin, the thin film of petroleum jelly should retain them in position The upper margins of the cast and surface of the impression should now be smeared with petroleum jelly and the foot replaced A further quantity of plaster should be mixed for the upper portion of the mould As soon as the cream shows signs of thickening it should be applied to the leg, being built up into a fairly thick, even coat When it has begun to set, before it has become quite hard, the strings should be pulled through the plaster (Fig 2) to divide the upper cast into medial and lateral portions which, when firmly set, should be gently lifted from the leg, and the foot withdrawn from the plantar section

The chiropodist will now have the complete negative of the cast in three portions (Fig 3), a plantar section and medial and lateral sections It is a good plan to stretch the skin away from the margins of the cast before it is set quite hard, thus assisting in loosening the cast from the skin Tufts of hair on the toes and dorsum of the foot, if present, should be shaved off with a razor before casting is begun

When the negative cast is completed, it is prepared for the making of the positive cast A thin coating of petroleum jelly is applied to the inside of all three sections, and the margins which fit together to form the complete mould are also liberally smeared, after which the three sections are gently pressed together and secured by binding with a length of twine or strips of zinc-oxide plaster When the assembled mould has

shaken gently to force the plaster into every nook and corner. When the mould is filled, it should be set aside for at least an hour to allow the plaster to become quite hard When thoroughly set, the securing band should be removed and the upper sections separated from the cast, which is now removed from the plantar section. If the operation has been carried out correctly, the chiropodist should have a perfect replica of the patient's foot and ankle (Fig. 5).

SHELL CASTING.—A method of casting which produces a much lighter cast and results in the saving of a considerable quantity of plaster is the shell casting method, the technique for which is as follows:

When the mould has been prepared to receive the plaster for the positive cast, a quantity of liquid plaster is poured into it This is now rinsed round inside the mould until it forms a thin coat over the whole inside surface Before the plaster can properly set, the operation is repeated with a further and slightly greater quantity of plaster, providing a more substantial layer than the first. Further layers may be applied by the same technique until the plaster shell is built up inside the mould to the required thickness In making a shell cast, great care should be taken in the mixing of the plaster, for whereas the solid cast may survive with a poor mixing there is little prospect that the shell cast will do so If the plaster is correctly mixed, a good firm shell will result, which will be satisfactory in every way, being both light and economical.

Small Plaster of Paris Casts

Negative impressions of small areas of the foot can also be taken with plaster of paris, this method being quite suitable for impressions of such conditions as bunion, calcaneal and cuneiform exostosis. The technique for casts of this type is quite simple, and is carried out in the following way

A piece of strong paper of suitable size is folded into about three thicknesses, the skin over the area of the cast is lubricated, the plaster mixed to a rather stiff consistency and placed on the paper As soon as it shows signs of setting, it is gently lifted and pressed over the part to be cast The plaster and the

been secured, it is well to pass the hand inside and smooth off any surplus petroleum jelly which may have been squeezed through the joints A hole should be bored at the toe end of the cast to allow air to escape and prevent it being trapped in the mould as the plaster is poured in The plaster for the



FIG 5
The positive cast

positive cast is now mixed to the consistence of a full-bodied cream that will pour freely The cast should be held at a slight angle and the plaster poured in slowly until it is filled (Fig 4) If the plaster is allowed to slop into the cast in large quantities, pockets of air may be trapped in the mould, in which case large indentations may ruin the cast When sufficient plaster has been poured in, the mould should be



FIG 6

Simple method of taking plaster of paris impression of a bunion

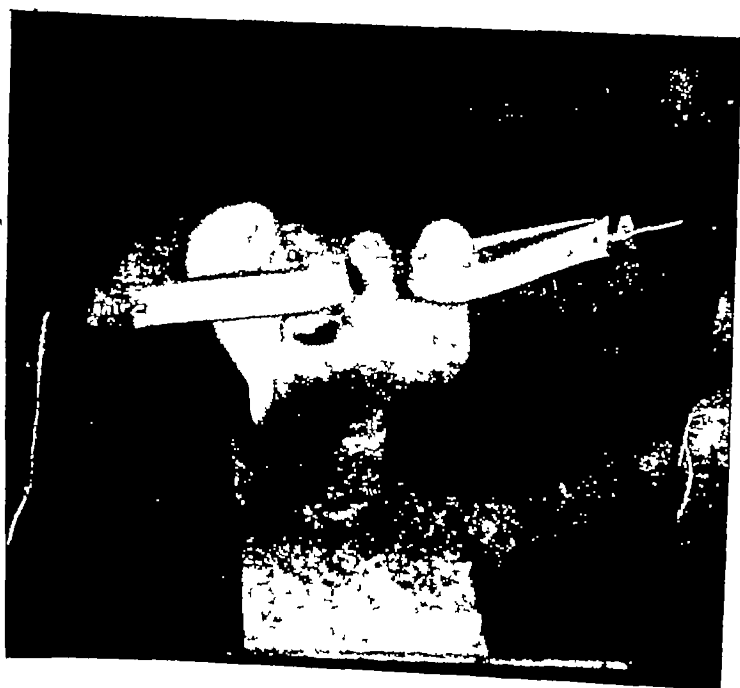


FIG 7

Toe-separating device for impression taking

foot should be held perfectly still until it is set, otherwise the impression will be cracked or distorted When the plaster is set it should be gently removed from the foot and should result in a faithful impression of the part to which it has been applied (Fig 6) A positive cast is now made in the way previously described

If it is desired to take a plaster cast of any of the lesser toes, it will be found necessary to take the negative in two parts The adjacent toes should be held away from the toe to be cast, so that the necessary working space is provided This can be achieved by an assistant holding the toes apart with loops of cotton bandage and applying traction, but it will be far more convenient to use a simple device to accomplish this object without involving the use of an assistant Such a device is quite easy to make and is a simple piece of apparatus

The device consists of a board about 14 in long and 9 in wide and 1 in thick At the middle of each side are fitted posts, 12 in in height Holes are bored through the posts about 3 in and 6 in from the top Two leather loops about ¾ in wide are made for fitting round the toes To each loop is fitted a length of cord The cords are passed through the holes in the post with the loops on the inside Two notches or hooks are placed near the base of each post to which the lengths of twine can be secured The appliance is used as follows. the foot is placed in the centre of the board, resting on the posterior aspect of the heel The loops are passed over the toes adjacent to the one of which the cast is to be taken The cords are then pulled through the holes until the toes are separated to the required extent The cords are then fixed in their retaining notches or hooks (Fig 7) In use the board should be placed on the foot rest of the chiropody chair This will be found suitable for most forms of casting Once again, however, it is well to remember that, when taking the cast, the toe should be held at the correct angle to the foot, corresponding to the pitch of the foot in the shoe It should be prepared for casting by the application of a little lubricant which is applied well into the interdigital spaces and the dorsal and plantar aspects A little tray of



FIG 6

Simple method of taking plaster of paris impression of a bunion

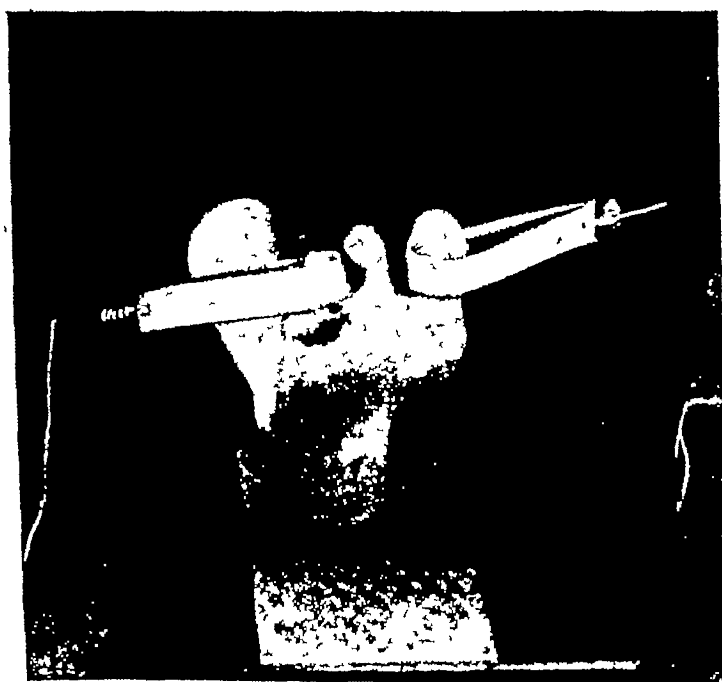


FIG. 7

Toe-separating device for impression taking

stiff cardboard is now made, which should be long enough to pass just beyond the end of the toe at the front and on to the plantar aspect at the back to an inch beyond the base of the toe. The tray is made by turning the sides of the cardboard up at right angles It should be wide enough to contain the toe and a reasonable quantity of plaster at each side About 1 in of each side of the tray should be cut away at the rear to allow this amount of the floor of the tray to project along the plantar aspect of the foot when it is held in position for casting

The tray should carry sufficient plaster to allow the toe and portion of the foot immediately over the projection to be pressed into it and leave at least ¼ in clearance. When all is ready, the toe and the part of the foot involved are placed in the plaster, which should extend about half-way up the sides of the toe The foot and tray are held perfectly still until the plaster has set hard (Fig 8) The exposed edges of the cast are now lubricated and more plaster is applied to the top of the toe and over the dorsum to an extent similar to the plantar projection The toe will now be completely enclosed in plaster, and this negative cast should be left in position until it is quite hard The bottom portion is now removed, after which the dorsal half of the cast is gently lifted away from the foot Care should be taken to see that the tongues of plaster constituting the dorsal and plantar projections are not snapped off in removing the cast from the foot (Fig 9) The two halves of the mould are treated in the same way as the larger casts, then lubricated on the inside and on the edges and carefully fitted together

The dorsal and plantar projection portions are open at the sides, and these must be enclosed by binding with zinc-oxide strapping In this way the mould is completed and is ready for the making of the positive cast It may be mentioned that the small dorsal portion included in the finished cast is necessary when making the toe appliance to cover the area where the tab lies The tab is used to assist in pulling on the appliance and securing it on the toe when a stocking is worn

Another method of making plaster of paris negatives of the



FIG 8

Plaster of paris toe casting



FIG 9

Negative plaster of paris toe cast, showing cardboard tray.

lesser toes is to fit a piece of strong linen thread round the sides of the toe and on to the dorsum, where the ends of the thread are secured by pieces of zinc-oxide plaster. The thread should pass round the toe about midway down and round the end, a little below the free edge of the nail The tray is placed in position with some plaster already in it When the toe has been bedded into the plaster in the tray, the remainder of the plaster is applied over the rest of the toe and dorsum When the plaster has started to set, one end of the thread is detached from the foot and brought round the toe, cutting the cast into dorsal and plantar portions The plaster is retained in position until quite set, when the two halves can be removed and the positive cast made in the usual way

Casting with Plaster Bandage

FOOT AND ANKLE —Negative casts can be made by the use of plaster of paris bandage instead of the loose plaster The old-fashioned method of making such bandages is to put loose plaster into open-wove-cotton bandage which has been unrolled on to a flat surface The bandages are re-rolled and stored in a tin to exclude damp

We have now, however, a specially prepared form of plaster bandage which is not only already prepared but incorporates a binding substance which makes the plaster firm in the bandage, and in consequence is much more convenient to handle than the bandage containing the loose powder plaster Negative casts of a very high standard can be made by using Gypsona bandages

The method of using these bandages is to place them in a bowl of water and allow them to soak until all bubbling ceases The bandage is then laid round the leg in a spiral, overtopping each turn by about half the width of the bandage When this has been carried from the ankle to the toe it is a good plan to place a plaster strip down the whole length, one from ankle to toe down the front of the foot and a posterior strip carried under the heel a'ong the sole to the toe, overlapping the toes on to the dorsum Another spiral of bandage can now be applied which should be adequate for the leg part of the cast

It is advisable to reinforce the sole by a further two or three plaster strips carried from about two inches up the back of the heel and up over the dorsum of the toes to about the same distance, and two strips should be carried from the back of the heel along the sides of the foot, overtopping the dorsum at the base of the toes These strips should embrace the sides of the foot and overlap on to the sole.

A cast made in the way described will be just thick enough in the leg portion to be firm but not so thick as to be difficult to cut with scissors The stirrup strips and plantar strips give the required reinforcement for the foot where the greatest weight of the liquid plaster on the positive cast will be taken. After the whole foot cast has set, it should be cut down the front with plaster scissors, when it can be eased off the foot like a boot that has had the laces loosened Very thin strip metal can be laid down the dorsum to the toes before plaster is applied and the plaster cut over the strip with an old scalpel kept for the purpose It is advisable when preparing for this form of casting to cut strips of bandage of the required length and number before casting is begun The author has found that if each strip of bandage is held in the hands, extended and dipped in the water before applying, the cast can be built up quite easily. The secret of getting a clean, well-defined positive cast is to see that the first layers of the negative are applied correctly. The first layer of bandage should be moulded cleanly on to the skin following the contours of the foot and then the creamy plaster should be gently massaged through the bandage so that it contacts the skin evenly It is this gentle creaming of the first layers through to the skin that is the secret of a good cast If this is not done the inside of the negative will have a rough-cast appearance showing the texture of the bandage, and as a result the positive cast will reflect this indifferent finish

Slipper Casting —If only a shallow cast is required, a slipper cast can be made, using the Gypsona bandage. It is again necessary to cut a number of lengths of bandage—4-in or 5-in bandage is very suitable for this purpose The strips should be of two lengths, and about six pieces will be required

for the plantar surface of the cast, which should extend from about three inches up the back of the heel, along the sole and over the front of the toes to the metatarsal joints, about four pieces of bandage are needed for application round the heel, along the sides of the foot to the ends of the toes As the name of this form of cast implies, the bandage is applied to the foot in such a manner as to form a slipper A plantar strip is first applied and then a lateral strip, the latter being brought on to the dorsum and forming a "V" at the point where the plantar piece finishes (Fig 10) If a square finish is desired, the lateral strip can be carried straight down the sides, the upper part of it coming on to the dorsal surface of the foot at the metatarsus and toes and the lower passing round the sides of the foot on the plantar surface The lateral and plantar strips are applied alternately until the four lateral strips have been used, after which the two remaining plantar strips are applied to give extra strength to the bottom of the cast. When set, this cast can be eased off the foot by pulling it gently down at the heel, and when it is released it can be gently eased forward off the toes.

FOREFOOT CASTS —Plaster bandage casts can be used for forefoot casts which are often necessary when making appliances for the metatarsal-phalangeal region It will again be found better to use strips of appropriate width for this purpose First a strip is taken over from the dorsum to the sole of the foot and extended as far up the foot as required for the cast The plaster is well creamed with the fingers, particular attention being paid to the interdigital and plantar aspects of the toes A strip is now taken round the foot and should just cover the previous strip. This is also gently worked into a smooth cream with the fingers This is done so that the smooth creamed plaster will penetrate through the crinoline and form an even coat next to the skin, thus forming a clean and accurate mould Two or three more longitudinal and transverse strips will complete the negative, which should be finished by gently massaging the surface plaster into a clean, smooth surface This plaster shell will be reasonably strong, consisting, as it does, of firm, hard plaster interposed with

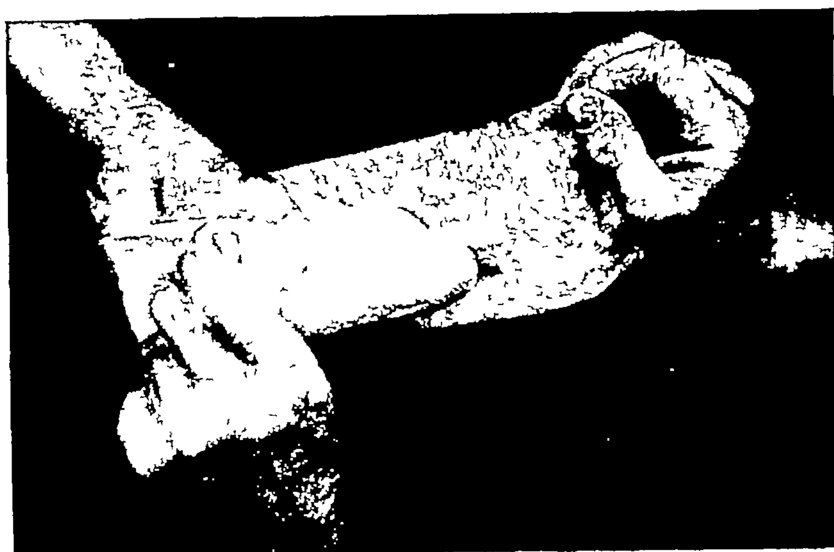


FIG 10

Method for taking negative slipper cast
with plaster of paris bandage

FIG 11

Negative and positive casts (plaster of paris bandage)

layers of cotton crinoline forming a strong reinforcement When the plaster has set hard, the skin should be stretched away from the edges to loosen the cast, which can be still further loosened by gently twisting it a few degrees clockwise and anti-clockwise, after which it can be drawn off the foot (Fig 11)

Bunion Casts —A bunion cast can also be made by the use of plaster of paris bandage This may be done by cutting strips each about one and a half inches wide and of sufficient length to pass from the base of the great toe round the end and to a point about two inches beyond the posterior aspect of the joint The first strip is dipped in water and then placed on the outer side of the toe at its base and passed round the end of the toe to the point posterior to the joint as already referred to This strip is gently smoothed on to the toe, and a second strip is placed along its dorsal aspect to a point level with the first strip The second strip should generously overlap the upper margin of the first strip When the second one has been smoothed into place, a third strip is taken over the end of the toe starting from the base of the nail over the end of the toe and along its plantar surface This strip should be extended to the posterior margin of the first and second strips Shorter reinforcing strips should now be laid along the toe overlying the first ones but not extending over the end of the toe To ensure adequate strength for the joint portion of the cast, a further strip can be taken along the outer side of the toe over the joint to the base of the existing strips This one should be wide enough to cover all the other strips over the joint but not on the toe When this medial strip has been applied, a final strip—long enough for two lappings—is carried round the toe transversely When set hard, this mould can be drawn off the toe quite easily after it has been gently twisted a few times to loosen it from the skin, and when removed it will be found to be quite strong The positive cast is made in the usual way, care being taken to avoid trapping air in the toe and thus spoiling the cast It is advisable to pierce the end of the cast to allow the air to escape as in the larger foot cast.

Putty Casting

The writer has found that this method which he introduced some eighteen years ago is ideally suited to casting for corrective appliances It consists of placing in a metal tray of suitable size a quantity of plumber's putty This is spread out into a slab of from 1½ to 2 in. in thickness. The quantity of putty required is about 3 to 4 pounds per foot Impressions of both feet can be taken in one tray, but to avoid any risk of distortion it is advisable to use a separate tray for each foot

After the putty tray has been prepared, the surface of the slab is rubbed lightly with the hand until it is smooth and even The foot is now dipped into tepid water before it is placed on the putty, so that the latter will not adhere to the foot when it is pressed home. The patient sits on a chair and the foot is grasped by the practitioner The heel is inverted and placed on the putty while held in this position The chiropodist places his other hand round the leg just above the inner malleolus and exerts sufficient pull to prevent the heel going into eversion The assistant is now instructed to press down the head of the first metatarsal and then press the putty against the sides of the foot, taking care that it comes well up round the sides of the heel and medial and lateral borders Without allowing the foot to depress, the patient is instructed to lift it straight out of the putty On doing so, it will be found that a perfect impression of the corrected foot will be left (Fig 12) It will be of depth varying overall from 1 to 2 in. The plaster of paris is now mixed to a thick cream and poured into the impression Before the plaster has set hard, any particulars, name, date or other such details as desired by the chiropodist can be marked on the flat upper surface of the cast

In about twenty minutes the putty can be pressed away from the cast, which when lifted out will be found to be a faithful representation of the plantar surface and sides of the foot (of ample depth for the purpose of making the required surgical insole) When the cast has been removed, the putty should be kneaded together again Machine oil should be added in the proportion of about 1 teaspoonful to each 3 or 4



FIG 12

Putty impression taking

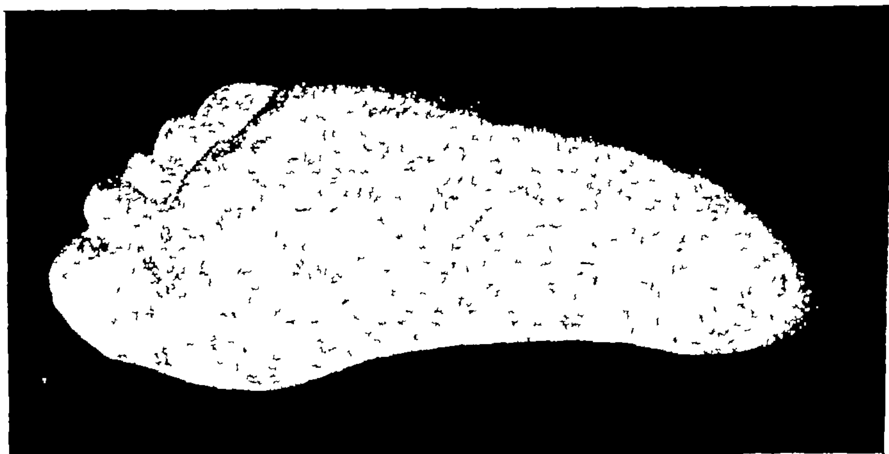


FIG 13

The plaster cast

pounds of putty each time a cast is taken, as it absorbs a considerable amount of oil from the putty Machine oil has been found to be more suitable than boiled linseed oil in putty used for casting as it does not dry out and allow the putty to become hard In fact, putty which is kept adequately impregnated with machine oil can be used innumerable times The putty compound can be made with whitening and a light machine oil Mastic putty has recently been used with great success as it does not harden so quickly as ordinary putty Putty can be kept in good working condition if immediately after use it is thoroughly kneaded and placed in a receptacle with sufficient water to cover it

The cast should now be prepared for appliance making The overlap of plaster at the upper edge should be removed, leaving a clean edge In spite of the faithful detail of skin marking on the plantar surface of the cast, the surface should be lightly polished smooth without damaging the detail of its contours It should be given a day or two to dry out, when it will be ready for use in the making of the appliance (Fig 13).

Impressions for palliative insoles can be taken in the same manner without the application of correction to the foot

Casting with Dental Composition

This material is excellent for the making of small impressions, such as of a joint, one of the lesser toes or even the forefoot, but casting is more difficult on the larger areas, as the composition hardens very quickly and does not allow much time to apply it This material is supplied in flat cakes, a number of these cakes being contained in one carton When placed in hot water the composition becomes quite soft and can be easily worked with the fingers A piece of the required size should be modelled with the fingers into the correct shape and then applied to the part of the foot to be cast As already mentioned, it should be quickly placed on the area to be cast, smoothed into position and the foot held still for a short time when the material will be found to have set quite hard.

When making a bunion cast involving the great toe, the lesser toes should be held well away from the great toe to give

ample working room. The compound should be pressed over the joint and round the toe and the edges brought together along the side of the toe. When set, these edges should be very carefully strained open but only sufficiently to release the toe, as the material is very brittle when set and the slightest overstrain may snap this portion off the main body of the cast. It is also as well to note that should an impression of this material be inadvertently dropped after it has set, it will shatter into pieces

The advantage of this material for casting is that once the negative cast has been successfully taken and hardened it will not distort and will remain true to shape unless softened by heat

A cast involving all the toes and a small part of the forefoot can be made by preparing a sheet of the composition of a length and width to enclose all the toes and the portion of the dorsum required. When heated, the material is applied to the plantar surface of the foot and pressed into the depressions on the plantar aspects of the toes. Then the composition is passed over the ends of the toes along the dorsal aspect, again being pressed into the interdigital spaces, etc. The sheet of material should be of sufficient width to allow about half an inch surplus at either side when it has been moulded on to the foot. This surplus material at the lateral edges should be bent at right angles to the rest of the cast so that the edges can be brought together as flanges, fitting truly to each other but not fusing When the composition has been pressed into place and the flanges have been brought together, this cast is removed as described for the bunion cast, by straining open the edges sufficiently to allow the cast to be stripped off the toes The edges are then brought together again and the flanges fastened together with zinc-oxide plaster This type of negative cast does not require any lubricant and the mould can be filled without further preparation When the plaster has set, the compound can be softened by dipping in hot water, when it can be peeled off the positive cast Another advantage of this material is that it can be used repeatedly All that is required is to place it in hot water until soft and then to work it into the required shape for re-use

Casting with Dental Wax

This material is particularly suited to the taking of impressions of small and intricate objects For this reason it is well suited to the taking of lesser toe impressions and impressions for bunion appliances Forefoot impressions are successfully made by using the same technique as with the dental composition. Dental wax is made up in thin sheets and is pink in colour, and packed in cartons of 50 sheets each When cold, it is quite hard but is readily distorted Being in thin and delicate sheets, its application requires considerable care. Particular attention should be given to preventing distortion when removing the negative cast from the foot, and the practitioner should endeavour to harden the wax while it is on the foot by the application of cold water to minimise the risk of distortion However, the impressions obtained by this method of negative casting are so perfect and detailed that the use of this material for small casts is well worth the extra care involved

The author uses the following technique in the taking of small toe casts A dish of hot water and a dish of cold water are placed conveniently beside the foot, also two or three cotton-wool swabs are laid handy A sheet of the wax or a portion of a sheet, according to the size required, is dipped in the hot water It is gently lifted out and laid over the area to be cast In the case of a bunion cast, the wax is brought round the toe to the outer side, the two edges being brought together (Fig 14). The lesser toes will, of course, have been retracted for the purpose of allowing the necessary working space The wax is gently pressed on to the joint and on to the dorsal and plantar surface of the foot When the wax has been carefully applied, the cold water is applied over it with a cotton-wool swab, the dish being held under the foot to catch the water as it drains off When the wax has been hardened in this way, the edges which have been nipped together on the lateral side of the great toe are opened slightly but only sufficiently to allow the cast to be drawn off, after which they are gently brought together again (Fig 15) and the cast is placed

in a dish of cold water which completes the hardening. Then it is removed and the surplus water shaken off The posterior



FIG 14

Taking a wax impression for a bunion shield



FIG 15

The wax impression after removal from the foot

margin of the negative may be turned up at right angles so as to control the plaster when it is poured into the mould To enable the wax to be bent without fracturing, the rear edge is

immersed into the hot water to a point where the bending is to take place This process must be done carefully to avoid distorting the rest of the cast When the mould has been filled and the plaster set, the positive cast may be removed by dipping in hot water The wax will soften and it can be gently peeled off This fairly inexpensive material was at one time thrown away as it was not thought worth while spending the time necessary for perparing it for use again If care is taken in removing the wax from the positive cast, however, it should not be difficult to reconstitute a workable sheet The cast is placed in hot water until the wax is sufficiently soft to be peeled off without fracturing It is again placed in the hot water and straightened out with the fingers as much as possible, after which the wax should be placed on a flat surface and rolled out with a bottle or other suitable implement. If the bottle is heated by filling it with hot water, rolling out will be further assisted. If a heated bottle is used, however, very little pressure should be applied, otherwise the sheet will be pressed out into too thin a wafer The writer has found an ordinary cold bottle adequate if reasonable speed is used in carrying out the operation Wax sheets reconstituted in this way can often be used several times

Plantar impressions for sole casting can be made by using wax sheets Unfortunately, however, the size of the sheets is too small to take other than a child's cast, and if larger casts are to be taken it will be necessary to fuse two or more sheets together To take plantar casts by this method it is necessary to have a sheet of sponge rubber about two inches thick On weight-bearing, the foot sinks into the sponge rubber, and in this way the wax sheet is moulded to the shape of the sole of the foot The wax is dipped in hot water and laid on the rubber, after which the foot is placed into position on it Although the author has made several casts successfully by this method, he has not found it as reliable or convenient for large sole casts as impressions taken by the putty casting technique.

In taking a cast of one of the lesser toes, a satisfactory method is to cut a strip of wax of sufficient length to pass over the toe

from dorsal to plantar aspect, extending it to an inch beyond the base of the toe The width of the wax should be sufficient to enable the toe to be sandwiched between it and the wax nipped together along the sides The wax is softened by being immersed in hot water in the usual way, it is then laid along the dorsum of the toe and a little way on to the instep It is then brought round the end and on to the plantar surface, after which it is pressed on to the toe, and the edges are brought together along the sides in the form of flanges The dorsal and plantar portions of the wax should be pressed on to their respective portions of the foot When hardened, the wax should be slightly hinged open and slipped off the toe and the edges again brought carefully together In filling the cast the toe portion should be filled while the plaster is liquid The wax forming the dorsal and plantar portions should be held between the pieces of cardboard, which provide a means of boxing in The remainder of the plaster should be poured into this portion when it begins to thicken In other words, the plaster cream should be of sufficient body as not to find its way easily through the edges of the wax and cardboard As soon as it has sufficiently set, the cast may be laid conveniently away until it is hard enough for the removal of the wax

Another method is to carry the wax on to the dorsal aspect of the foot, but only to the base of the toe on the plantar aspect The toe is filled with plaster cream and as it begins to thicken it is trowelled on to the dorsal portion of the wax, being built up sufficiently thick to be reasonably strong Before the plaster is thoroughly hard the edges may be squared up with a spatula or knife

Casting with Zelex Impression Composition

For the making of small and delicate casts, particularly if acute angulations are involved, the practitioner will find Zelex the most perfect material available When prepared, Zelex has the consistency of a thick paste which is applied round the toe with a small thin spatula When set, it has a rubbery consistency which allows the practitioner to withdraw the negative of the toe and even stretch it over an enlargement, as

the material has a sufficient degree of elasticity to resume its original shape This composition is highly suited to the taking of lesser toe casts, bunion casts, forefoot casts and heel casts However, in the main it will be found rather expensive for use in the larger casts, and will serve the chiropodist best and most economically in the casting of the lesser toes. It should be noted that if Zelex is to be used successfully, the greatest possible care should be taken in its preparation and the instructions supplied with the material followed out to the letter. The materials consist of a small phial of pink powder and a substantial canister of another powder The powder contained in the small phial is dissolved in a specified quantity of water To make the Zelex composition, the practitioner weighs equal weights of solution and powder, after which the powder is added to the solution When mixing is begun, it may appear that there will not be sufficient solution to dissolve all the powder, but it will be found that when completely mixed, a firm paste will result For a single toe cast the author found that solution sufficient to fill a 2-oz glass measure is adequate The following method is used to obtain the correct weights of solution and powder

Use is made of a chemist's balance A 2-oz measure is placed on each tray of the balance, any difference in weight being adjusted until an exact balance is achieved One measure is filled with solution, and the powder is then added to the other measure until a balance is again reached The solution is then placed in a more suitable container and the powder added and thoroughly mixed Although more robust scales can be used for the making of larger quantities, it has already been pointed out that this method would prove too expensive for large casts except when casting for a special purpose In the course of a few hours the Zelex mould will be found to have lost most of its elasticity This, however, is a matter of only academic interest, as by then the positive cast will have already set When the plaster has set, the Zelex is pulled off and thrown away, as this material cannot be used again

CHAPTER III

LATEX MILK RUBBER

MILK RUBBER or Liquid Latex is the juice of the rubber tree and is extracted by "tapping," i e an incision is made in the bark of the tree trunk This fluid contains between 30 and 40 per cent rubber, and on exposure to the air coagulates quickly because of evaporation of the moisture. Coagulation is prevented by the introduction into the fluid of an alkaline stabilising agent, usually ammonia water It is in this stabilised form that latex milk rubber is used by the chiropodist, and it is sold in this form by the shoe and leather sundriesmen and dental supply houses If kept in a tightly sealed tin or well-stoppered bottle, latex milk will keep in good condition for about two to three months The lid or stopper should be placed on the container immediately after use, as repeated and prolonged exposure to the air will evaporate the stabilising agent and result in coagulation and rapid deterioration of the latex On purchasing latex milk it is advisable to see that the supply is fresh, and so ensure its keeping in good condition for a reasonable period of time Should the chiropodist desire to dilute the latex, this can be done by adding a few drops of ammonium hydroxide and a quantity of distilled water The latex may be applied by a variety of methods, namely dipping, brushing on or spraying

Dipping

When the dipping method is used, the cast should be carefully prepared Some practitioners prefer to coat the cast with a sealing substance such as shellac varnish or cellulose cement, etc The method advocated by Woolf is to immerse the cast in water and not remove it until all bubbling has ceased and the cast is absolutely saturated It is claimed that this method prevents the formation of air bubbles between the latex and the cast

The prepared cast is immersed, apex first, in the milk rubber and gently moved about so as to ensure a thorough coating, after which it is placed to dry, apex uppermost. By placing the cast in this position any remaining surplus of latex will flow back over the whole area of the cast Each coat is dried and the dipping repeated until a sufficient number of coats have been applied to build up to the required thickness Usually ten to twelve coats are adequate

Padding may be introduced in the form of felt or surgical sponge rubber, the latter is most favoured, although soft felt has proved quite successful The padding is introduced after the application of four or five coats of the latex milk When the padding has been carefully fitted and appropriately shaped, the remaining coats of latex are applied, enclosing the padding as part of the main structure.

Brushing On

For this method a small brush with soft but firm bristles is used—for a small cast a half-inch flat brush is suitable A dish of soap solution made by dissolving powdered soap or soap-flakes in water is required This solution is used to prevent the bristles becoming clogged together with coagulated latex by giving them a thin film of soap It is advisable to have another dish of clean water in which to rinse the brush out after each application of latex, the process being as follows. dip the brush in the soap solution, shake gently, dip in the latex milk, brush briskly over the cast, place the cast to dry, rinse brush thoroughly in water To repeat the application of latex milk, again dip the brush in soap solution, carry on as before When the final coat has been applied, thoroughly rinse out the brush in clean water

Spraying On

This method ensures an even coating of latex and is very satisfactory provided that great care is taken to prevent the jet of the spray becoming clogged with coagulated latex It is advisable to pass some ammonia water through the spray immediately after use, and to finish by using a liberal quantity

of clean water When the laboratory is organised for the processing of a considerable quantity of latex appliances, the milk rubber can be applied by the use of a pressure spray driven by an electric motor. The author has seen at least one small neat spraying apparatus most suitable for this work and quite inexpensive Such an apparatus will apply the numerous coats of rubber evenly, quickly and without undue waste

Drying

The drying of the milk rubber may be speeded up by the use of a hot-air drying oven A simple bunsen oven fitted with a thermometer is very suitable A temperature of about 120° F. will provide the required heat to dry out the latex in a few minutes Once the cast has become heated in drying out the first coat, succeeding coats will dry out even more rapidly A more elaborate form of drying oven is a thermostatically-controlled electric hot-air oven This type of oven will give very accurate control of temperatures, thus avoiding rapid variation in the temperature, with the accompanying risk of damaging the appliances being processed A drying oven of this type, 14 in by 18 in in size, will be adequate for the processing of a number of small appliances at one time A very satisfactory and inexpensive way of speeding up the drying of individual appliances is a simple process of holding the appliance in front of a gas or electric radiator, care being taken not to scorch the rubber

Accelerators

Accelerating solutions have been introduced which will induce an instant coagulation of each coat of rubber. By the use of such a medium a succession of coats can be built up in the space of a few minutes, a procedure that would take several hours by natural drying The accelerators used are acid solutions, the one most commonly used being acetic acid in a strength of 10 to 15 per cent Other acids may also be used One particularly advocated by Woolf is a solution of hydrochloric acid 5 to 8 per cent , which he claims to be most satisfactory. The author has experimented extensively with hydro-

chloric, nitric and acetic acids in a strength of 10 per cent and has found them equally satisfactory

PROCESSES

As a result of experiment extending over a number of years the writer has devised, in addition to the purely rubber appliances, two other forms of replaceable shields involving the use of latex milk rubber Thus three processes are presented for consideration The *first* is appliances made by the coating of a plaster cast with successive layers of milk latex in which padding of suitable materials is introduced The *second* is one in which a soft leather is introduced as the foundation of the appliance and upon which the padding and latex coatings are superimposed The *third* involves a more complicated processing technique In this process a soft leather foundation is used with torsion strips and reinforcement of cotton bandage This appliance may be completed by an outer cover of thin pliable leather As in the first and second process, padding is introduced at the appropriate stage The third type of device, although equally soft and resilient on the contact side, is firmer than those previously described and has the great advantage of retaining its shape throughout the whole of its life This form of appliance, if skilfully made, is by no means bulky, and if suitable leathers are used can be produced with an excellent finish that will delight both the practitioner and patient The author proposes to describe each type of appliance in detail, with modifications of each for consideration

PROCESSING OF TYPE I

For the processing of this type the author advocates the use of an accelerator The shield can be made entirely of rubber The advantages of this type of appliance are a minimum of bulk, resilience, simplicity and speedy processing As advocated by Woolf, the cast may be soaked in water before processing is

begun The author, however, has found no difficulty in making the appliances on a dry cast The equipment necessary is a dish of appropriate size to contain the latex, and the dish for the accelerating agent The cast is first dipped in the latex, gently moved about to ensure a thorough coating (Fig 16), after which it is withdrawn and the surplus shaken off It is then held, apex uppermost, to allow the latex to flow back evenly over the cast After holding it for a few moments in this position, the cast is immersed in the accelerating solution, withdrawn, the excess solution gently shaken off, and the cast again immersed in the latex This procedure is repeated until four or five coats of the milk rubber have been applied A sponge rubber pad is cut to shape, bevelled, and the aperture on the underside is also bevelled to ensure the pad fitting snugly against the contour of the prominence which it is designed to protect According to the desire of the practitioner, the protection may be designed in the form of a crescent pad or an oval shield with aperture (In the case of appliances necessitating props, these are shaped according to requirements) The most perfectly shaped pad is produced by fixing it in position, rough-shaping the outside with scissors and finishing this process on a high-speed emery wheel When completed, the pad is dipped in latex, then in the accelerator and immediately fixed firmly in position An alternative and more convenient method is to attach this pad with rubber solution When secured, it is trimmed to conform to the required contour, although the author has found it more satisfactory to complete the shaping of the pad before attaching it On completing the padding the final coats of latex are applied After the final dipping in the accelerating agent the appliance should be immersed in a strong solution of ammonia to neutralise the action of the acid It is next rinsed thoroughly under running water Although the thorough rinsing in water may succeed in removing the acid, it is advisable to make sure that none remains in contact with the rubber by using a neutralising agent (Fig 17) On completion of processing, the cast is set aside for from 24 to 48 hours to complete the curing process The next stage is thoroughly to

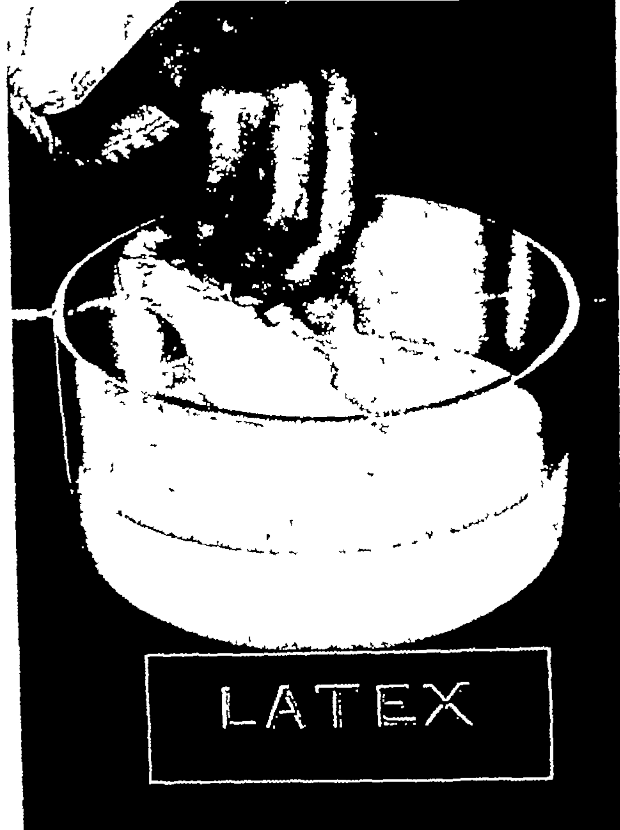


FIG 16

Dipping the appliance into latex (note apex first)

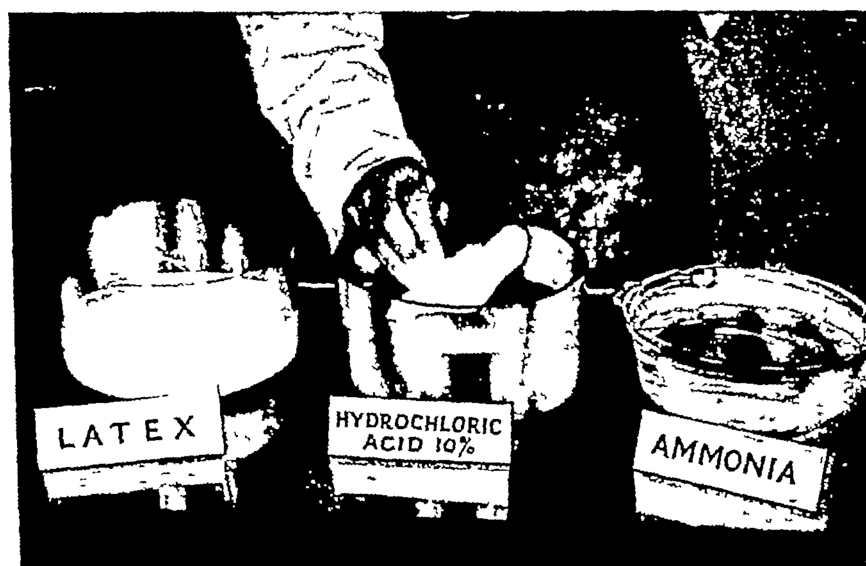


FIG 17

Appliance leaving the accelerator solution, apex first, to allow the acid to drain back over the cast and drip into the dish

dust the appliance with talcum powder, carefully to peel it off the cast and to trim off surplus with scissors A tough and substantial appliance can be produced by the application of ten to twelve coats, although a more delicate appliance, but one which will wear reasonably well, can be produced with a total of only eight coats

To assist evaporation of perspiration on wearing, an appropriate number of perforations may be made in the appliance by the use of a leather punch Patients wearing appliances of this nature should be advised to wash them frequently in warm water to which a little mild non-irritant antiseptic has been added, after which the pad should be thoroughly dusted with an antiseptic powder An appliance of this nature may be strengthened by reinforcing it with tulle or fine cotton bandage Where it incorporates the use of a toe glove, a reinforcing strip may be passed round the toe This strip will prevent longitudinal stretch and possible displacement of the appliance A reinforcing strip may be applied to the main body of the device, but where a prominence is involved an aperture should be cut in the material to avoid undue pressure on its apex The reinforcement should be applied after the third or fourth coat When it is decided that the rubber should not contact the skin, the appliance may be lined with a soft leather, e g surgical wash-leather This may be secured either by the use of latex or rubber solution It is not, however, practical to line deep cavities in this way, for instance, this could not be carried out in a toe glove fitting of an appliance The author, however, feels that if a leather lining is desired, technique No. 2 or 3 is indicated, as this begins upon a foundation of leather which meets the need in a more satisfactory way A large variety of appliances can be made by the first process, however, which give great relief to the patient Whilst the purely rubber appliances have an appreciable life, they do tend to deteriorate, losing their elasticity and shape as a result of body heat and excretion from the skin When the appliances are reinforced they retain their shape for a longer period. Devices made by this process have been used successfully for the protection of first and fifth metatarsal bunions and exostoses, chronic corns

on the lesser toes, and callosities associated with the hyper-extension of the distal joint of the first toe

As an alternative to sponge rubber, felt padding may be used In this case the external surface of the pad may be trimmed carefully with scissors or skiving knife.

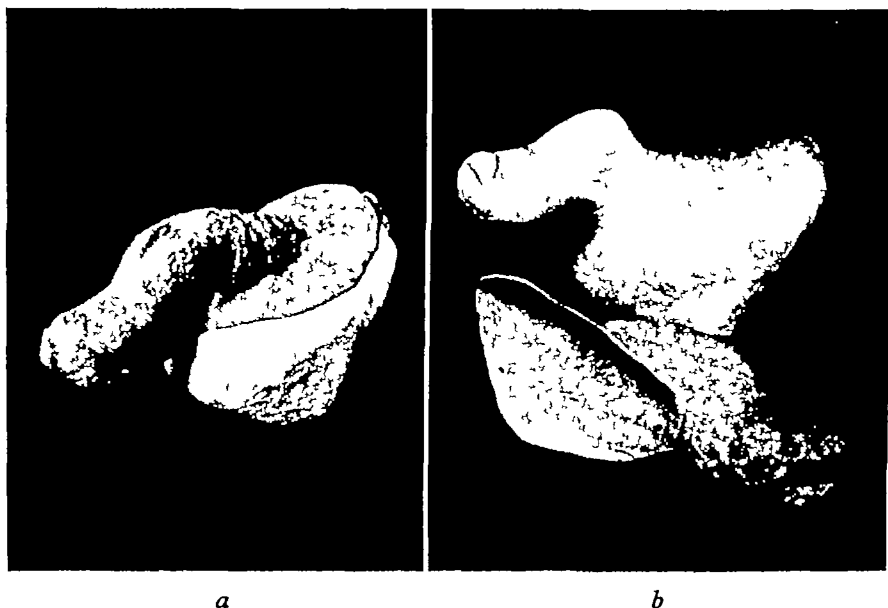
Hammer Toe.—Shield and Prop

In preparing a toe cast for this type of appliance it is necessary to include a portion of the metatarsus because the appliance is designed with a small tab which lies against the dorsal surface of the metatarsus and is used to pull on the appliance. The chiropodist now makes a crescent pad of surgical sponge This is used to protect the dorsal aspect of the inter-phalangeal joint The thickness of the pad is determined by the prominence of the joint or excrescence, usually ¼-in sponge rubber meets the case When this pad is completed an oblong-shaped pad is made, which is used to fit on the plantar aspect of the joint This type of pad is termed a plantar prop and acts as a rest for the toe In the completed appliance not only does the dorsal pad protect the joints from pressure and the plantar prop act as a rest for the toe, but the forward set of the plantar prop induces a lever action in wear, producing a mild corrective effect When the pad and prop are completed the next step is to apply the preliminary coatings of latex to the cast This is done in the manner previously described In dipping the cast in the latex, care should be taken to include the portion of the cast representing the metatarsus Next the pad and prop are dipped in the latex and the accelerator, and secured in the respective positions. The pads should be firmly pressed in position to ensure this.

The dipping process is now continued for the further six coats, after which the cast is rinsed in clean water and placed aside for some 24 to 48 hours to complete curing

When the rubber is cured, the appliance is liberally dusted with powdered chalk or talcum powder, after which it is carefully peeled off the cast Having been thoroughly dusted inside and out with the powder, surplus rubber is trimmed off with scissors, the pad being reduced to its final shape. Care

should be taken to see that a tab of appropriate size is retained As previously mentioned, this tab lies against the dorsum and is used to pull the pad into position on the toe At the discretion of the practitioner, the appliance may be left as a toe glove type, the toe being completely enclosed, or the apex of the appliance may be trimmed off, making it an open-end type



a *b*

FIG 18

a Appliance for terminal and dorsal corn Type II

b Terminal and dorsal corn Showing cast and finished shield Type II

of appliance In either case a suitable number of perforations may be made in the appliance by using a leather punch (Fig 18)

Appliance for Terminal Corn

This form of appliance is particularly successful and is a means of much comfort to many patients The sponge rubber for this appliance is shaped in the form of a plantar shaft pad, which extends from the base of the toe along its plantar aspect to the free edge of the nail The pad widens slightly towards its distal end A U-shaped cut-out is now made at this end of the pad, which when placed on the appliance is fitted with

the shoulders of the "U" fitting snugly round the site of the excrescence, thus relieving it from pressure In making this pad the chiropodist should proceed as already described, dipping the pad in the necessary preliminary coats, the fitting of the pad, and resumption of dipping to complete the appliance Any final shaping of the pad by trimming or scouring should be done before the final coats are applied.

Shield for Fifth Toe

A painful excrescence frequently occurs on the fifth toe as this digit is particularly exposed to pressure and irritation. It is therefore not surprising that this lesion often degenerates into a condition of chronic inflammation, with fibrosis of the tissue. An excrescence of this type lends itself particularly to treatment by replaceable shields The protective sponge rubber shield for this condition is frequently found most suitable if designed as an oval pad with aperture, although in certain circumstances the crescent-shaped shield proves suitable In the case of the oval shield, the aperture should be placed towards the anterior aspect of the shield Whilst being of sufficient thickness to offer resilient protection, this pad should not be unduly bulky. The margin should be carefully graduated away to blend into the appliance as a whole The cast for this appliance should extend generously up the lateral border of the foot so as to provide for a substantial tab The latter is necessary, as when hose are worn the tab is held securely against the foot and the pad firmly secured (Fig 19, *a* and *b*) When there is an excrescence occurring at the lateral base of the nail and the interphalangeal joint, the pad may be made as a double-crescent shield, the anterior shoulder moulding round the anterior aspect of the first excrescence, the posterior shoulder moulding round the posterior and dorsal aspect of the second excrescence, the central tail extending up between them In moulding the anterior shoulder of the pad round the excrescence, care should be taken to avoid the nail as far as possible. This pad, like the one previously described, should not be unduly bulky (Fig 19, *c* and *d*)

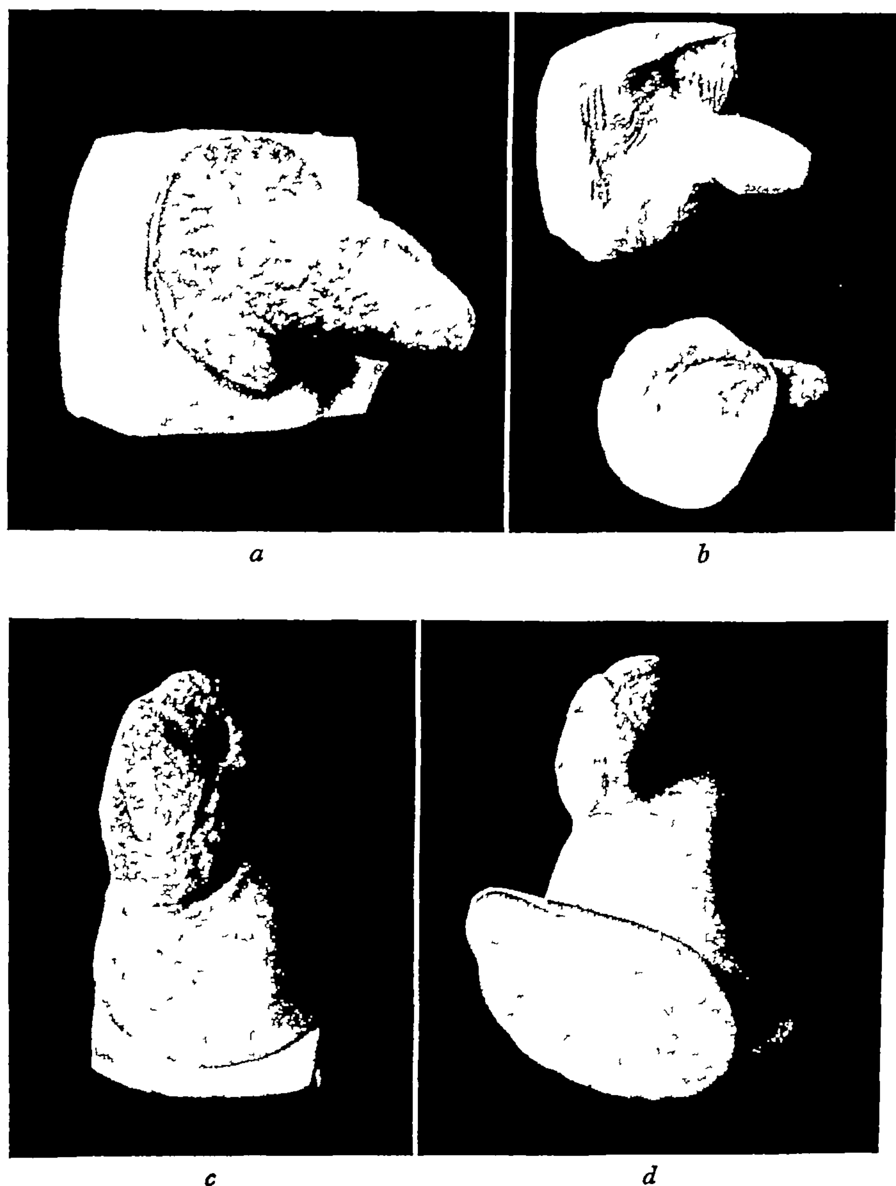


FIG 19

a Simple crescent shield for corn on fifth toe Type II

b Showing cast and shield Type II

c. Double-crescent shield for corns situated on dorsal and lateral aspects of fifth toe Type II

d Double-crescent shield showing cast and shield Type II.

Heloma Molle (Interdigital Fifth)

This device consists of a toe glove appliance with a tab extending well down the lateral border of the foot The interdigital aspect of the toe glove, however, is cut away up to the anterior margin of the excrescence, the sponge pad being sited on this anterior portion, acting as an interdigital wedge, keeping the toes separated, preventing pressure on the excrescence and allowing free aeration When corns occur on the interdigital

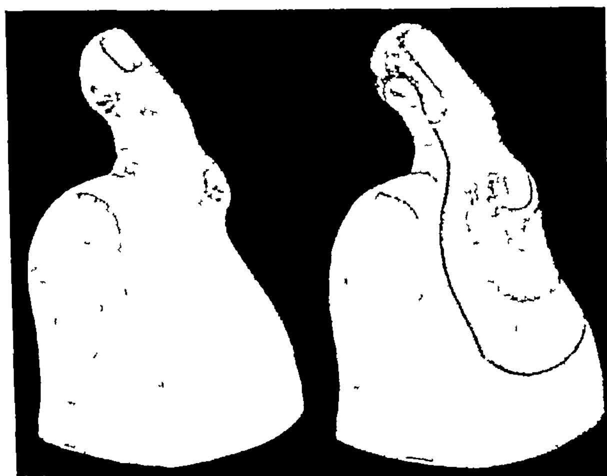


FIG 19

e Cast showing situation of corns

f Finished shield on cast Note interdigital pad anterior to corn

and lateral aspects of the toe, a combination of crescent and wedge may be used (Fig 19*e*)

Bunion Shield

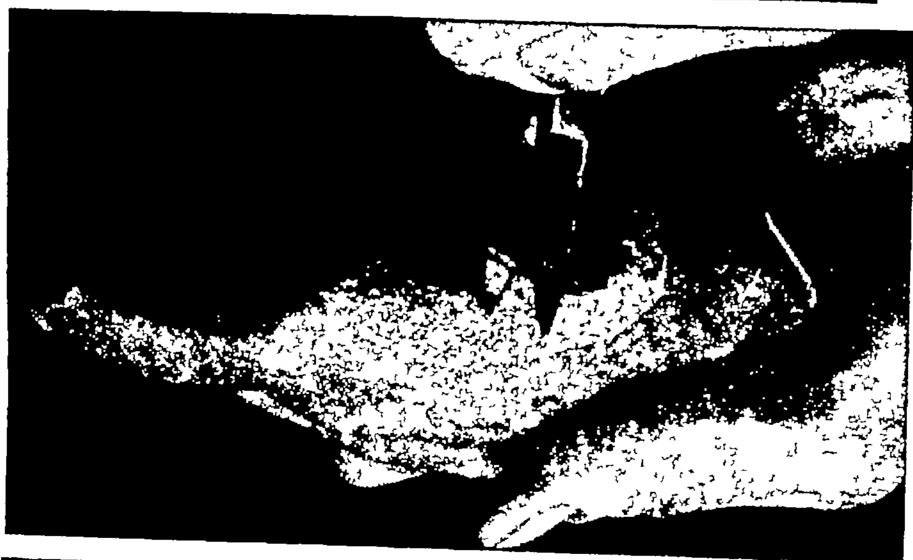
One of the most useful latex appliances is the bunion shield, which provides an ideal means of shielding the chronic bunion from friction and pressure This appliance may be made with toe glove and toe loop The processes for this appliance are the same as for the appliances previously described and differ little except that it is a larger edition It will be found advantageous, however, to reinforce the bunion shield with strips of cotton bandage or tulle In making the pad for this appliance

one has the choice between the oval pad with aperture and the crescent-shaped pad. When the aperture or crescent has been cut out, the edge should be bevelled so that when the pad is fitted the angle of the aperture or crescent coincides with the slope of the prominence (Fig 20*a*) This bevelling enables the pad to be moulded closely to the joint If the aperture is not bevelled the pad would stand back from the joint, leaving a vertical step which would considerably detract from the pad's effectiveness When the first four to five coats of latex have been applied to the cast, the pad should be fitted in position and shaped with the scissors to conform roughly to the contours (Fig 20*b*) If an emery wheel is not available, shaping should be completed with scissors The emery wheel, however, enables the practitioner to reduce the sponge in a clean and uniform manner so that the completed appliance has a more finished appearance (Fig 20*c*) When the final trimming of the pad is completed, a piece of the reinforcing material should be cut to the size of the shield and in the shape of a crescent or horse-shoe The material should now be dipped in latex and applied to the appliance with the tails of the horse-shoe forward These should be stretched taut round the margins of the pad and brought together at the base of the toe A strip of reinforcement is now run round the edge of the toe joining up with the reinforcement of the pad When the reinforcement is pressed firmly into position, dipping is continued until the required number of coats have been applied The application of the horse-shoe-shaped reinforcement at tension round the margin of the pad helps the pad in retaining its shape in wear, whilst the strip round the toe prevents elongation of the toe above, thus the pad cannot be distorted in wear Curing and trimming are completed as in the pads previously described This reinforcing process may be equally successfully applied to the lesser pads Pads so reinforced are not so easily damaged or torn and retain their shape longer in wear.

Protective Shield for Calcaneal Exostosis

For this purpose a cast is taken of the heel, care being taken to hold the foot at right angles when the impression is being





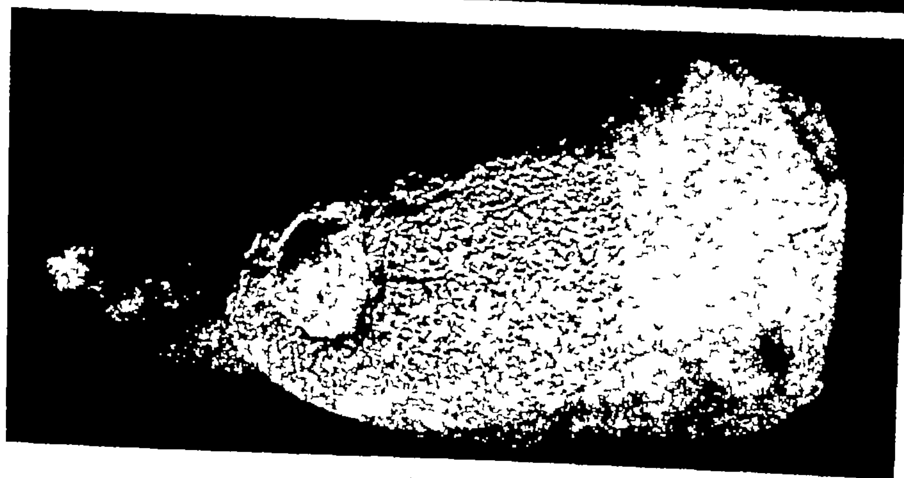


FIG 20

a Shaping underside of bunion pad *b* Shaping of the surgical sponge on the cast *c* Pad scoured to the desired shape

taken In making the pad for this appliance it is found that a pear-shaped pad and channel for the tendo Achillis is very suitable Great care should be taken to shape this pad correctly, the aperture and bevelling should fit accurately to the exostosis It is a good plan to fit a U-shaped reinforcement completing with a straight strip running round the approximate margin of the appliance, this being applied as a stirrup, the ends being brought together above the pad (see Fig 21) In



FIG 21

Protective shield for calcaneal exostosis

moulding this appliance, care should be taken to see that there is sufficient extension beneath the heel to ensure it being secured in position when the stocking is pulled into place

PROCESSING OF TYPE II

Bunion Shield

The second type of latex appliance differs from the first in that it is built upon a foundation of soft chamois leather

or doeskin In every other respect these appliances are constructed in the same way as the all-rubber type, with the exception of the method of applying the first coat of latex milk rubber This first coat should be applied very thinly and lightly, so that it does not soak through the leather When this preliminary coat has been applied, it is advisable to dry it off by applying gentle heat, e g holding the cast in front of a gas or electric radiator Great care should be taken to avoid overheating or scorching of the appliance For this first thin coat very little heat is required as the stabiliser will be evaporated and the rubber cured in a comparatively short space of time When this has been achieved, the process may proceed as in Type I, or the remaining coats may be applied with a brush and the rubber cured by heat after each application In this second process the padding is fitted after about three to four coats of the latex milk rubber have been applied Should the operator desire to complete the process by using an accelerator after the first application of latex, he may do so, providing that the first coat is cured by the use of heat It should be realised that as the accelerator is an acid solution the leather will be seriously damaged should the solution come into contact with it To avoid this, care should be taken to ensure that the first coat of latex covers the whole of the leather likely to be brought into contact with the acid, as by this precaution the skin of rubber will completely protect the leather An alternative method of protecting the wash-leather, which has proved highly successful, is to apply a thin, even coat of rubber solution, after which a succession of latex layers can be applied either by the brushing or dipping method The advantage of the solution method is that if lightly and evenly applied, there is no risk of its soaking through the wash-leather, and a positive protection is provided, leaving the wash-leather lining of the finished appliance unblemished The method of fitting the leather to the cast is one which requires a reasonable combination of care and skill A very fine textured chamois leather or doeskin should be used, and for lesser toe appliances a very thin leather should be chosen for the purpose In cutting out the leather it is advis-

taken. In making the pad for this appliance it is found that a pear-shaped pad and channel for the tendo Achillis is very suitable Great care should be taken to shape this pad correctly, the aperture and bevelling should fit accurately to the exostosis. It is a good plan to fit a U-shaped reinforcement completing with a straight strip running round the approximate margin of the appliance, this being applied as a stirrup, the ends being brought together above the pad (see Fig. 21) In



FIG 21
Protective shield for calcaneal exostosis

moulding this appliance, care should be taken to see that there is sufficient extension beneath the heel to ensure it being secured in position when the stocking is pulled into place

PROCESSING OF TYPE II

Bunion Shield

The second type of latex appliance differs from the first in that it is built upon a foundation of soft chamois leather

making small toe casts involving plantar props, the seam can be arranged to come beneath the toe so that it is concealed when the prop is applied In the case of the bunion shield, the seam can be arranged to occur on the interdigital aspect of the toe Although the second type of appliances are soft and kind to the skin, they do not keep their shape any longer than those made entirely of rubber Their advantage lies in



FIG 22
Method of lacing on the basic leather when a lining is required

having a soft leather as an alternative to the rubber next to the skin.

PROCESSING OF TYPE III

Bunion Shield

The preparation of this type of appliance is begun in the same way as for Type II, the soft leather base being fitted to the cast in exactly the same manner The deviation from this type arises following the application of the pad, as it is at this stage that the reinforcing strips are introduced The strips are made from cotton bandage treated with latex milk rubber

able to place the cast on the skin and then gently lay the leather round it. It should then be held in position while the leather is cut close to the edge of the cast, only a small margin beyond the cast being left. When the leather has been cut out, the portion which fits round the toe of the cast should be stretched and moulded round it so as to leave a surplus at the edges, which is turned back to expose the underside. These exposed surfaces are treated with latex milk rubber, which is brushed on lightly and thinly, after which it is dried off by use of heat as previously described. When this has been accomplished, the edges are nipped firmly together round the toe, which becomes enclosed in a glove finger. The surplus is now trimmed off, the leather being trimmed almost flush to the toe of the cast. Great care, however, must be taken not to burst the edges open. The latex is now brushed over the edges and dried in the manner previously described, after which a strengthening tape made from a strip of cotton bandage or suitable material treated with latex is pressed firmly in position along the edge, securing it to make it firm and strong.

The remaining leather covering the body of the cast is stretched tightly over it so that all the curves and contours are firmly embraced by the material. The leather, as it is stretched over the cast, can be secured by lacing, using a needle and strong linen thread (Fig. 22). In lacing the leather into position it is advisable to stretch it over the edges of the cast with the fingers, securing it by stitching it with the needle and thread. Should the chiropodist endeavour to draw the leather over by passing the needle through it and pulling on the thread, he will find the thread will tear through the soft delicate leather. An alternative method of securing the leather is to cut a strip of cotton bandage, apply latex to it, dry it and then cut into narrow strips about $\frac{1}{8}$ in. wide. The leather is stretched over with the fingers, a little latex applied to the part stretched over, the end of the securing strip of cotton bandage pressed firmly upon it, after which the opposing corner of leather is stretched over it, treated likewise with latex, the strip stretched across and secured to it. It is taken backwards and forwards across the cast in this way until the leather is completely secured. In

strips When the torsion strips have been applied a further coat is advised The outer leather, which should be very thin and soft, a fine basil split being very suitable, should be cut to shape



FIG 24

Torsion strips and laminations completed (left) The covering leather stretched over and the edges nipped round the toe (right)

by laying on the cast in the same way as for the foundation leather, but a considerably more generous margin should be allowed The underside of the leather should be treated with latex, which should be dried and the leather applied (Fig 24),

A strip about $\frac{1}{2}$ in wide is carried from a point just anterior to the joint and at the base of the toe around the margin of the cast, along what would constitute the plantar aspect of the joint, finishing at a point on the middle posterior aspect of the cast or just beyond it When this torsion strip is applied it should be held taut and kept tightly stretched during its application, its front point of anchorage being firmly secured



FIG 23
Applying the torsion strips

by the thumb A similar strip is now applied to the dorsal aspect, this strip slightly overlapping the first (Fig 23) Two further strips are now applied in a similar fashion, partially overlapping the first, but set further back towards the apex of the appliance A final strip is now applied down the centre of the appliance if desired, thus completely enclosing it in the reinforcing material This final strip is laid on the appliance and not applied under tension In this third process a further two coats of latex are all that is necessary to apply after the fitting of the padding and before the application of the torsion



a

b

FIG 25

a Completed bunion shields, toe glove type with inner lining and top cover *b* Toe loop bunion shields Appliance on the cast shows Type 2 The other is Type 3, covered inside and out with basil split

care being taken to avoid as far as possible undue stretching on Whereas the first leather should be firmly stretched on the cast, this outer cover should be only laid on, because if this is put on at considerable tension there is a risk of some degree of distortion when the appliance is removed from the cast, owing to contraction of the rubber. Rubber solution may be used as a satisfactory alternative for the attachment of the covering leather. However, if care is taken in applying the outer cover, this appliance will be very firm and will retain its shape throughout the whole of its life It should be noted that although the appliance is much firmer and stronger than those previously described, the part coming in contact with the skin is just as soft and resilient as those of less robust construction If thin leathers are used, this type of appliance need not necessarily be more bulky than that of Type I or Type II (Figs 25*a* and 25*b*) It should be pointed out, however, that although this method of processing is ideally suited for the larger shields and appliances, it is not suitable for the small appliances for the lesser toes As an alternative to the toe glove type of bunion shield made by this third process, a toe loop appliance can be made which often pleases the patient who dislikes the feeling of the whole toe being enclosed In processing, the basil leather is only carried forward of the joint and does not involve the toe Before fitting the final covering leather, the loop is made, consisting of a strip of chamois leather, which is latexed on one side and folded over, enclosing a tape of cotton material The latter is to prevent stretch in wear This loop strip is now placed round the toe to measure the correct length required It should be long enough for the ends to extend to about $\frac{1}{4}$ in on the shield The ends are now bevelled, latex rubber applied, dried and the loop placed in position round the toe, the ends being firmly pressed in place on the shield The shield is now finally latexed, as is also the outer cover, which, when dried, is pressed in position The lacing is now cut and the appliance is slipped off the cast, the loop being passed over the toe, trimming and shaping proceeding in the normal fashion

In conclusion, it should be mentioned that the bunion shield

CHAPTER IV

METATARSAL AND TOE APPLIANCES, USING LATEX, CHAMOIS LEATHER AND SPONGE

Combined Dorsal Pad and Plantar Prop

THE materials used in this appliance are surgical sponge, cotton bandage, latex milk rubber and chamois leather (Figs 26 and 27) The appliance is of particular value because it effectively combines both the principles of protection and correction The dorsal pad of surgical sponge is D-shaped, with a straight edge forwards The curved edge has a long graduated bevel The lateral margins, however, where they meet the straight edge, are abruptly curved The width of the pad is designed to encompass the second, third and fourth toes, inclusion of the fifth toe has not been found satisfactory Three deep flutings are snipped from the under surface of the straight edge which allows the pad to fit snugly on to the dorsal aspects of the toes and close to the joints The flutings leave small rubber partitions which prevent the toes from crowding and assist alignment

The plantar prop is an oblong-shaped wedge of rubber which, like the dorsal pad, is designed to involve the three toes only As the toes reduce in length, the prop tapers slightly towards the lateral side In this way the difference in the length of the toes is allowed for and the prop will sit snugly in position To make the appliance the following procedure is adopted.

A piece of fine chamois leather is cut to fit the D-shaped pad In cutting it to shape, the leather is first folded over so that when trimmed it represents an oval and will completely enclose the dorsal pad when folded over it The milk latex is now applied to the pad and also to the chamois leather on one side only When the latex is dried the leather is carefully

in Type II can be made into a toe loop appliance by cutting off the glove, leaving only sufficient width to provide a loop round the toe If desired, this loop can be reinforced by the application of a tape and additional coats of latex

prop is set slightly forward of the dorsal pad Combined pressure on the dorsal pad and plantar prop results in a lever action tending to straighten out the toes The author has used this appliance extensively and it has proved consistently

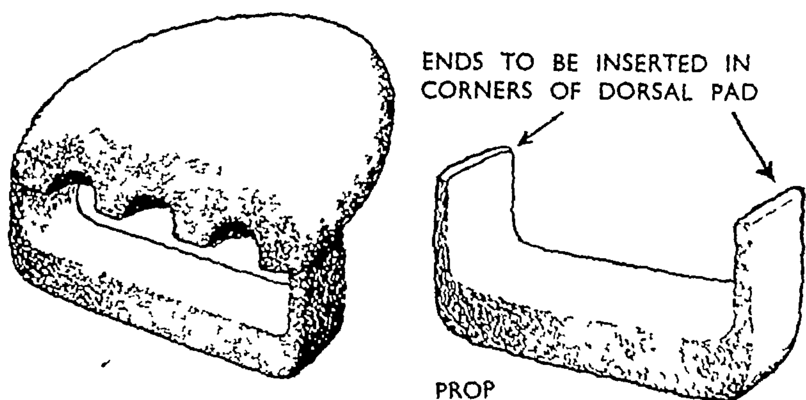


FIG 27

Dorsal pad and plantar prop shaped and showing method of covering

effective (Fig 26) It may be noted that the device can be successfully made without involving the taking of a cast. It is, however, worth while to do so if time permits, as correct fitting of the pad to the cast during processing will ensure perfection in the completed appliance

folded over the pad and pressed firmly to it It is nipped closely round the edges, except near the ends of the straight edge which are left open In fitting the chamois leather cover it should be pressed firmly into the flutings The next stage is to enclose the plantar prop in similar material The enclosing leather should be of sufficient length to allow a generous margin at either end of the prop The plantar prop is attached to the dorsal pad by inserting the ends of the chamois leather into the open ends of the dorsal pad It is, of course, necessary



FIG 26
Clinical photograph of dorsal pad and plantar prop

to latex them before inserting them, after which the open ends of chamois leather on the dorsal pad should be pressed firmly down, completing the appliance

Any surplus round the margin of the dorsal pad should be trimmed away The pad is fitted by slipping the toes between the dorsal pad and plantar prop, the toes sitting in their respective flutings The prop is adjusted beneath the toes The dorsal pad should now be positioned with its straight edge immediately behind the dorsal aspect of the proximal interphalangeal joints

On careful observation it will be noted that in considering the relative positions of the dorsal pad and plantar prop, the

material may be chamois leather, doeskin or fine basil It is a good plan to use chamois leather or doeskin for the side applied to the skin, and the more substantial basil leather for the outside cover Again, in fitting these leathers the sides must be left open to allow for insertion of the elastic brace

A good method is first to fit the leather over the dorsal aspect of the pad, in other words, the side that fits next to the foot The appliance is now held against the cast in its correct position, and the brace, the ends of which have been latexed, is

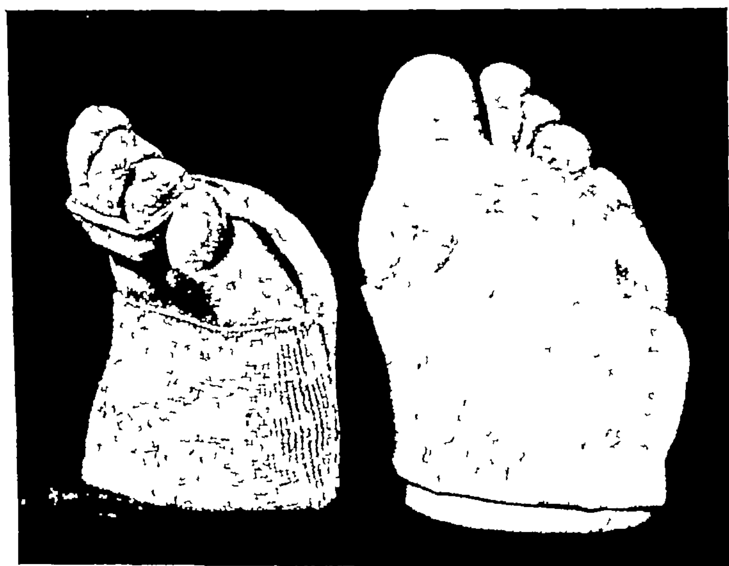


FIG 28

Metatarsal pad and brace appliance, with and without toe loop

stretched round the cast and the ends pressed firmly in position on the under surface of the pad which has been previously latexed The outer cover, the underside of which has been similarly treated, is then pressed firmly into position By this method of processing the ends of the brace can be carried well on to the under surface of the pad, thus securing them more firmly

The completed appliance may now be removed from the cast and the edges of the leather finally trimmed down Although it is not essential, a row of machine stitching round the edges of the pad makes for additional security

Metatarsal Pad and Brace

This appliance, which is familiar to all chiropodists, is frequently used to replace a similar form of padding and bracing with adhesive felt and strapping

There are several ready-made variations of this device which function with varying degrees of efficiency Certain facts have emerged, however, in the fitting of these pads One is that the pad should protrude slightly forward of the brace, as this assists in countering the tendency to creep back in wear The tendency to creep back is a common fault of this type of replaceable appliance If the pad is extended forward with a slightly longer bevel, the foot on weight-bearing would tend to anchor it Another fact is that in severe cases of depression of the metatarsal arch, particularly in cases associated with pes cavus, the metatarsal heads tend to overshoot the padding, which proves in consequence absolutely useless Again, in such instances this forward extension of the pad considerably improves its efficiency

There are three versions of this particular appliance One incorporates the familiar pear-shaped pad, whilst the other two types have extensions or wings The appliance may have a single or double extension (Fig 28 (right)) There is yet another type devised by the author which has a forward extended bevel with toe loop This type of appliance will be described separately, and it may again be pointed out that pads of this type may be made without the use of a plaster cast The surgical sponge for the pad can be shaped and trimmed against the patient's foot, and the dimensions of the brace ascertained A forefoot cast, however, will provide the chiropodist with a replica of the foot with the relevant defects upon which the appliance can be built with greater accuracy

In shaping the sponge rubber pad used in this device, care should be taken to see that its front margin corresponds to the curve of the metatarsal heads Where the pads incorporate an extension it is important that these should curve snugly round the heads of the metatarsal bones they are to support When the pad is completed, the leathers may be shaped The

material may be chamois leather, doeskin or fine basil. It is a good plan to use chamois leather or doeskin for the side applied to the skin, and the more substantial basil leather for the outside cover. Again, in fitting these leathers the sides must be left open to allow for insertion of the elastic brace.

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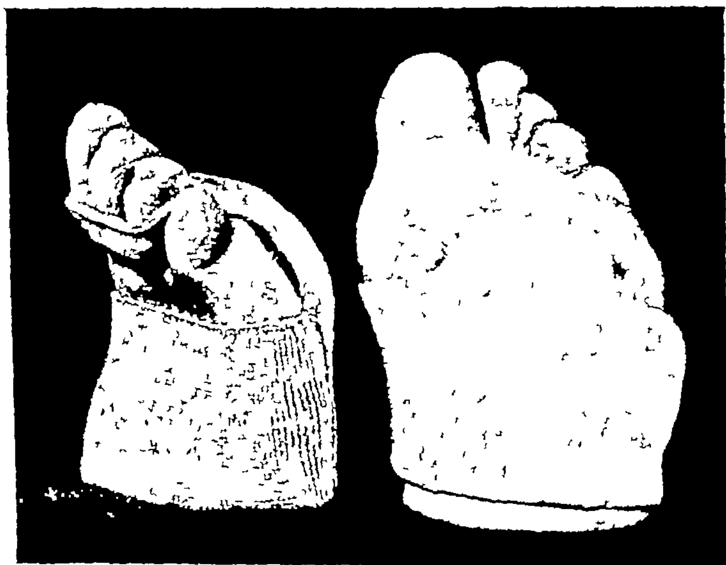


FIG 28

Metatarsal pad and brace appliance, with and without toe loop

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There are three versions of this particular appliance One incorporates the familiar pear-shaped pad, whilst the other two types have extensions or wings The appliance may have a single or double extension (Fig 28 (right)) There is yet another type devised by the author which has a forward extended bevel with toe loop This type of appliance will be described separately, and it may again be pointed out that pads of this type may be made without the use of a plaster cast The surgical sponge for the pad can be shaped and trimmed against the patient's foot, and the dimensions of the brace ascertained A forefoot cast, however, will provide the chiropodist with a replica of the foot with the relevant defects upon which the appliance can be built with greater accuracy

In shaping the sponge rubber pad used in this device, care should be taken to see that its front margin corresponds to the curve of the metatarsal heads Where the pads incorporate an extension it is important that these should curve snugly round the heads of the metatarsal bones they are to support When the pad is completed, the leathers may be shaped The

and the toe should be held in the corrected position whilst the plaster is setting It is advisable to remove the lesser toes from the finished cast as this will simplify the fitting of the toe glove portion of the appliance The wash-leather should be stretched upon the cast in such a manner as to involve the great toe, the plantar aspect of the cast up to the base of the lesser toes and on to the dorsum on the medial and lateral sides leaving a space of about two inches This portion should be secured by a few stitches, using a needle and linen thread The anterior margin of the plantar portion of the leather may be secured in like manner, tying the stitches across that part of the cast from which the lesser toes have been removed and securing to the anterior margin of the leather on the dorsal portion of the cast Before stitching, the leather should be thoroughly stretched on to the cast so that it fits closely to its contours The leather for the toe glove is trimmed so that the edges meet on the lateral aspect of the toe The edges are turned back, latexed, nipped together, cut flush and secured with tape.

The next stage is to apply three or four coats of latex to the leather A piece of surgical elastic 2 in wide and about 4 in long is now prepared by applying latex milk rubber to each end, covering about 1 in of the elastic The dorsal stitches should now be cut and the edges of the leather finally trimmed The elastic brace portion is now secured to the leather in such a way as to exert a degree of stretch or tension This is necessary if the correct bracing effect is to be achieved when the appliance is worn The anterior margin of the plantar leather should again be stitched to the dorsal leather A further coat of latex is applied to the surface of the leather and to the portion of surgical elastic attached to it, after which the sponge rubber bunion pad and plantar metatarsal-phalangeal pad may be secured in position They should be rough trimmed before fitting, but when fixed in position they should be finally shaped by the use of scissors or, better still, by a high-speed emery wheel (see Fig 29*a*) Latex is now applied over the whole surface of the appliance

The next stage is to prepare a piece of crinoline with latex

The brace for this appliance may be ordinary surgical elastic or the new latex lace which is a more delicate and openly-woven material

Metatarsal Pad with Elongated Bevel and Loop

There are certain cases where there is a marked clawing of the toes and the pain is located well forward beyond the metatarsal-phalangeal joints At the conclusion of a course of treatment involving infra-red irradiations and breaking down of the adhesions round the metatarso-phalangeal joints, a metatarsal pad with a long bevel and forward extension, to which is fitted a loop of padded wash-leather (incorporating cotton tape to prevent stretching), will prove most beneficial A rather large dome is made of surgical sponge with an exceptionally long bevel Wash-leather is now shaped for the surface coming into contact with the skin Again, basil or kid will be suitable for the outer leather The cover is extended forward so that it comes to the base of the toes A brace of surgical elastic is fixed to secure the pad to the foot The wash-leather loop is now attached at one end only It is advisable to fix the other end of the loop at the time the appliance is fitted to the patient's foot to ensure complete accuracy The effect of the loop which passes round the three middle toes is to prevent the pad creeping back and to draw the toes down into position The forward extension of soft leather acts as a comforting insulation (see Fig. 28 (left)).

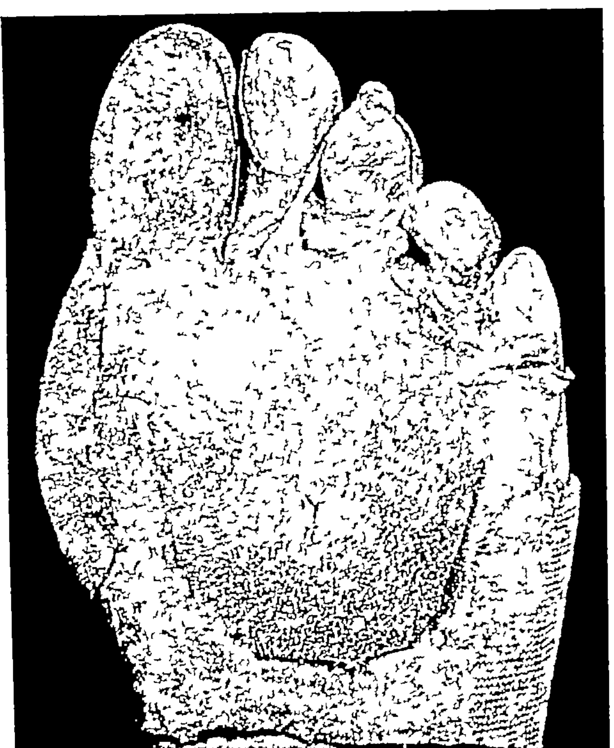
Combined Bunion Shield and P.M.P. with Brace

There are occasions when this combination appliance will meet the requirements of the practitioner Involving the use of toe glove and elastic brace it exerts some degree of corrective traction on the great toe An appliance of this nature, however, does necessitate the co-operation of the patient in the matter of footwear A modified natural form last is essential if the appliance is to function effectively. To process this appliance a forefoot cast is necessary The cast should involve the whole of the tarsus anterior to the malleoli In making the negative it is advisable to use Gypsona plaster of paris bandage

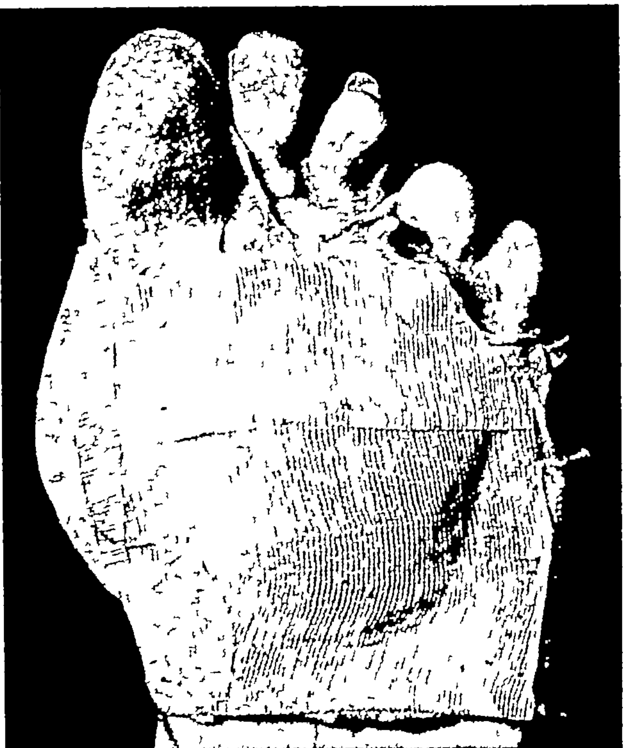
milk rubber and apply over the plantar and lateral surface up to the margin of the leather The bunion shield is reinforced by torsion strips of latex crinoline or cotton bandage (see Fig 29*b*) The appliance is now ready for the application of the outer cover. This should be carefully shaped with a reasonable margin of surplus material This and the appliance should now be latexed When the latex rubber is dry, the outer cover may be stretched in position Great care is necessary in doing this to avoid unnecessary pleating The cover should be nipped round the inner margin of the toe and trimmed flush The appliance is removed from the cast, after which the final trimming is completed Should the practitioner desire to prepare an exhibition appliance for a school collection or lecture purpose, the lesser toes may be left on the cast if a separate cast is taken of the great toe. The toe portion of the first leather can be built upon this, after which it can be pulled like a glove finger on to the full cast Processing is continued in the normal way until the stage of applying of the final leather cover has been reached This is secured in position with the exception of the portion covering the great toe, after which the appliance is removed and the separate toe cast again inserted into the toe glove of the appliance to enable the practitioner to complete the securing of the covering leather The appliance illustrated in Fig 30 is prepared by the author in this fashion

Traction Toe Sling for Overlapping Fifth Toe (*after Budin*)

Overlapping fifth toe has received the consideration of a number of authorities from time to time, but experience has proved that a toe sling on the lines described by Dr. Harry A Budin, M Cp of the First Institute of Podiatry of Long Island University, offers, so far, the best solution to this problem The appliance devised by Budin is made from strip rubber, but a sling made of chamois leather and reinforced with latex and linen was made on the same principle This terminated in two inches of silk elastic and a small hook, an eye to receive the hook was attached to the sling on its dorsal aspect This



a



b

FIG 29

a Surgical sponge secured in position and scoured to shape (The toes were left on this cast as it was for exhibition purposes It is usual to remove the lesser toes from the cast in order to facilitate the making of the toe glove) *b* Laminations in position

appliance has been most comfortable to wear, and as a corrective measure has been very successful

This appliance, whilst in no way deviating from the basic principles of that devised by Budin, and made from sheet rubber, has, in certain circumstances, been found more comfortable to wear, principally on account of the chamois leather next to the skin, also because the actual toe loop can be modified, and, if necessary, slightly padded at the base of the interdigital aspect of the loop.

It should be noted when making this appliance that the amount of traction exerted upon the toe must be carefully regulated Frequently it is advisable to increase the traction by gradual stages Satisfaction is rarely found in the use of an appliance of this nature for treatment of adults except as a post-operative measure, when the appliance will prove most useful. An appliance involving the principles of the Budin sling will as a general result prove highly successful for children (Figs 31 and 32)

Toe Splint with Heel Loop Attachment

This appliance is used for correcting an overlapping fifth toe, either congenital or acquired

The splint is attached to the toe by an elastic loop, and passes along the plantar surface of the foot to a point posterior to the cuboid An elastic loop attached to the base of the splint is passed round the heel The method of securing the splint is very satisfactory, the appliance being easily and speedily fitted and not visible from the dorsum of the foot

The device is made in the following manner.

A piece of spring steel is acquired of sufficient length to pass from the distal end of the toe to about one inch beyond its base A flask-shaped cover of wash-leather or other suitable material is made. A strip of half-inch elastic sufficient in length to stretch round the toe and attached to the splint is procured, as is also a similar strip of elastic for the heel attachment A good plan is to complete the appliance minus the heel attachment, fit the appliance on the toe, attach one end of the heel



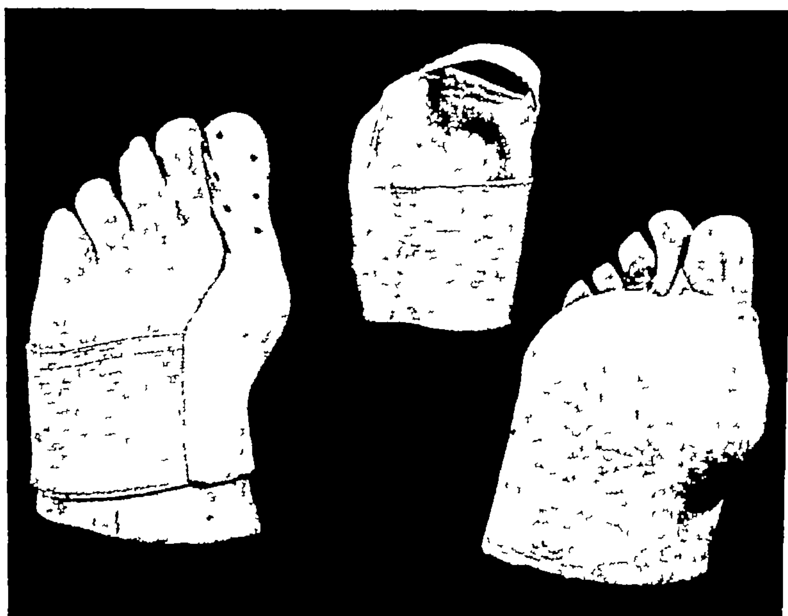


FIG 30

a Completed toe-glove appliance incorporating a bunion shield and a metatarsal dome *b* Combined metatarsal dome and bunion shield with brace, showing alternative methods of toe glove or toe loop

elastic only, pass it round the heel, exerting the required tension, cut off the required length and attach

To make the splint a piece of flask-shaped chamois leather is prepared by applying the latex milk rubber and placing down on bench or table, the latex-covered surface uppermost. A piece of thin sponge rubber is now placed in position, extending from the base of the leather covering the broad portion of the flask The metal splint is now placed in position and secured by a slip of cotton bandage previously prepared with latex The toe loop is now fitted, the loop extending on the wash-leather side of the appliance A flask-shaped piece of basil leather which has also been prepared with latex is attached at the toe loop and fitted firmly down the neck of the flask, but left free at the broad portion The appliance is now fitted on the toe and one end of the heel elastic placed in position round the heel and attached as previously described The basil leather is then pressed firmly into position

While shaping the flask-shaped leathers it should be noted that the neck of the flask should extend the whole length of the toes and slightly beyond, the body of the flask constituting the remainder It is advisable to run a row of stitching across the base of the leather to ensure complete security of the heel loop Stitching may likewise be applied to the toe loop with a similar object in view It has been noted, however, that these appliances do appear to stand considerable wear and tear even when the stitching is omitted

When making appliances of this nature, a slipper cast of the foot is usually taken, pressing the toe in the corrected position during the setting of the plaster. The toe is also held slightly away from the fourth toe.

On completion of the positive cast the plaster may be removed from between the fourth and fifth toe by the use of a hacksaw blade This cast provides a perfect model upon which the appliance can be built and fitted

This appliance was devised by the author not only to bring the toe back into the normal position but also to correct the rotation (Fig 33)



FIG 31
Congenital overlying fifth toe

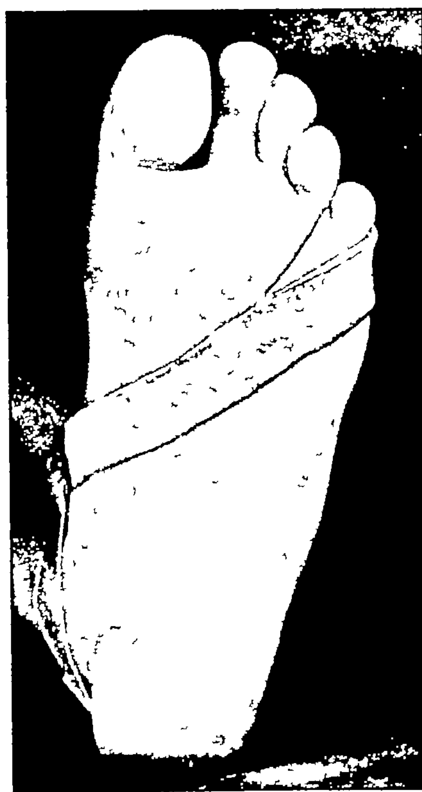


FIG 32
A modification of the Budin sling

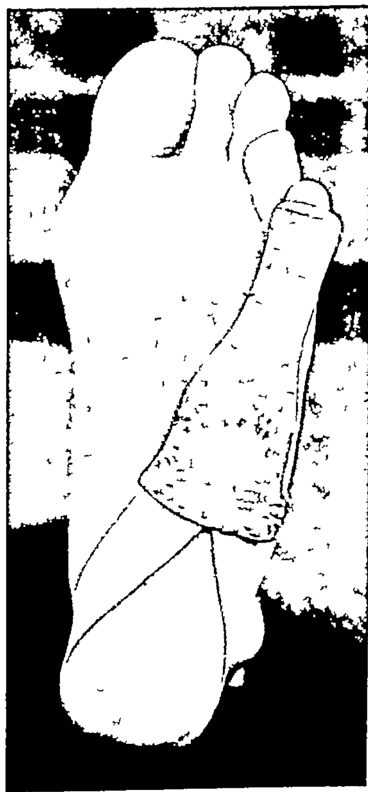


FIG 33
Toe splint with heel loop attachment

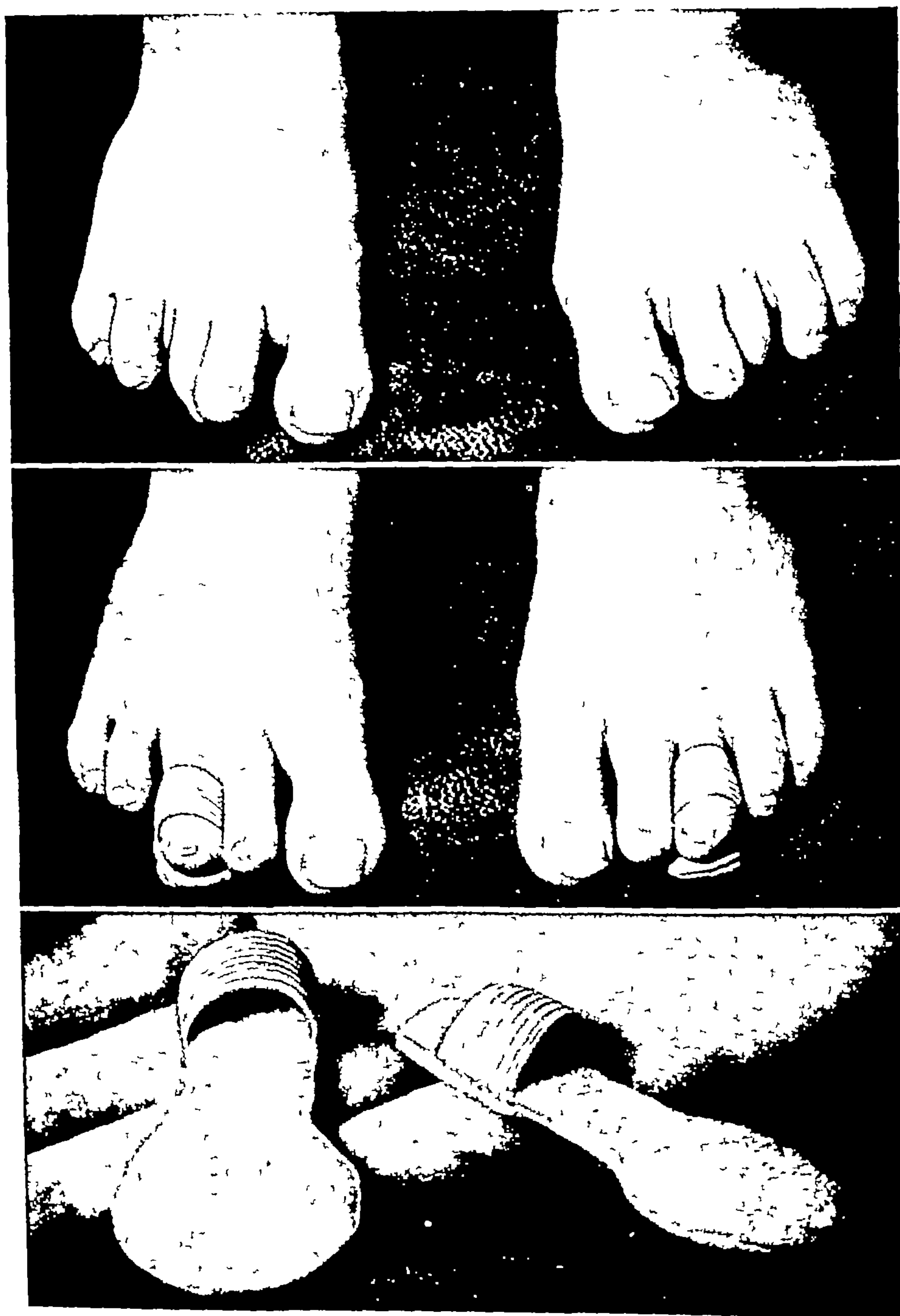


FIG 35

a Underlying third toe *b* Correction achieved by use of a banjo splint
c Banjo toe splints

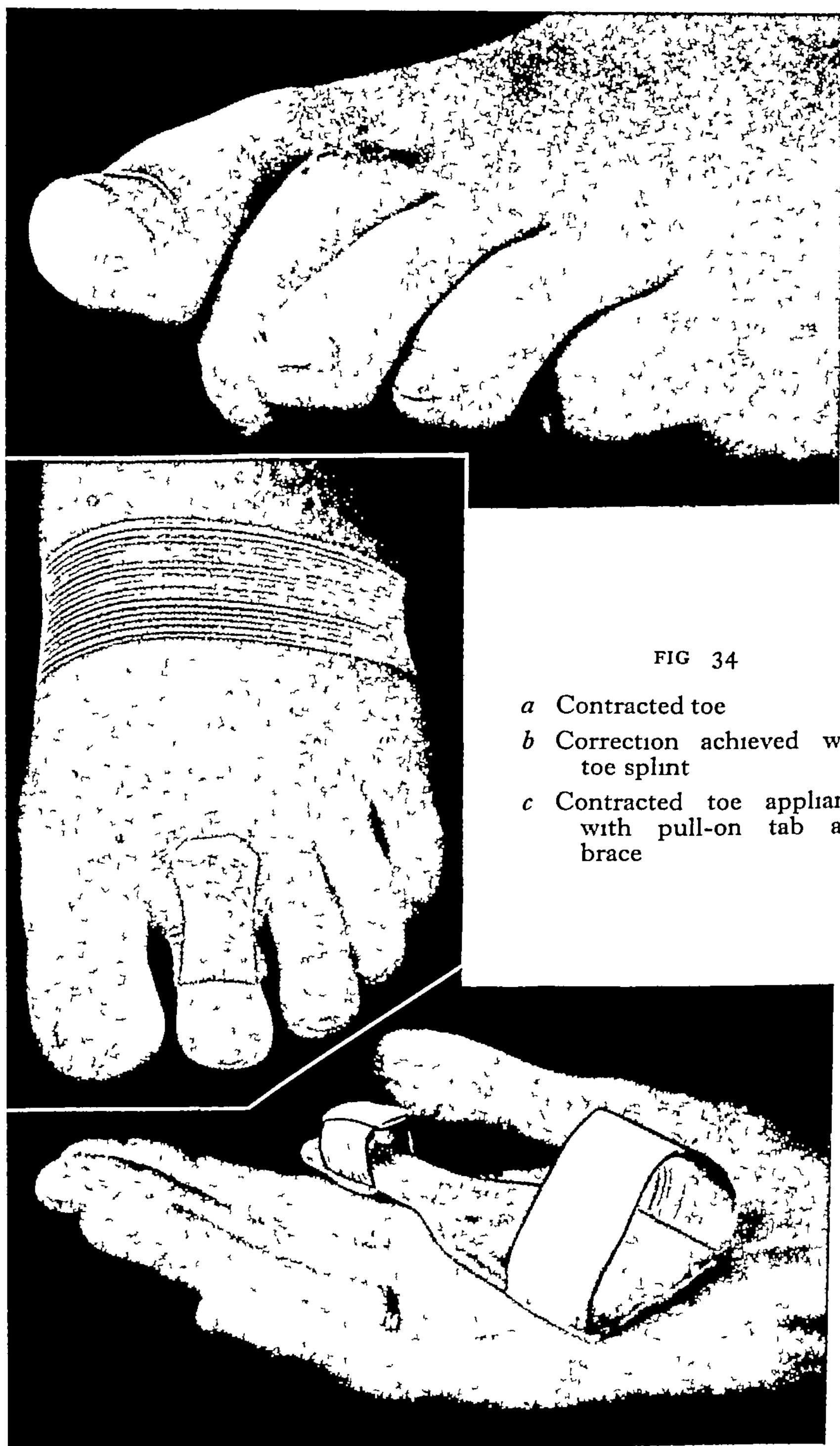


FIG 34

a Contracted toe

b Correction achieved with toe splint

c Contracted toe appliance with pull-on tab and brace

The tab is made by cutting a strip of the thin wash-leather, latexing it and applying to the elastic band by folding it over with the ends protruding to the rear When the tab has been secured it may be finished off by rounding with scissors (see Fig 35)

Contracted Toe Appliance

There are many cases of contracted second toe which, unlike most hammer toes, can be wholly or partially straightened under pressure The toe when contracted brings the inter-phalangeal joint into prominence This condition is associated with a subluxation of the metatarsal-phalangeal joint

A simple and effective appliance for this purpose was designed by the writer many years ago The appliance consists of a strip of spring steel encased in leather, the device is flask-shaped, and near the end of the long neck, which acts as a splint, is an elastic loop which passes round the toe At the posterior or broad end of the appliance is attached a large elastic loop, which passes round the foot with its anterior margin behind the first and fifth metatarsal heads A pocket is provided for a metatarsal pad, which may be found useful in some cases to assist correction of the subluxation of the metatarsal-phalangeal joint This appliance is particularly effective in the early stages of the condition before any ankylosis of the inter-phalangeal joints has taken place This appliance is, of course, constructed in the usual way The loop may be reinforced with cotton bandage and secured with latex and milk rubber (Fig 34)

Toe Splint without Brace (Banjo Splint)

This form of toe splint consists of a metal splint merging into a circular disc at its base, the splint stretching from just beyond the end of the toe to beneath the corresponding metatarsal head It is the disc-like portion which is situated over the latter The appliance is covered in wash-leather or other suitable material A loop of surgical elastic about ¾ in wide is fitted to the splint at a point where it will pass over the distal inter-phalangeal joint A small tab of thin wash-leather may be fitted centrally on the loop to assist in pulling it in position This tab should be carefully skived at the edges and should be sufficiently wide to cover the dorsal aspect of the joint so that the patient will not be conscious of any ridge

second portion consisting of a strip about 1 in wide and of sufficient length to form an anchoring loop passing round the heel and attached to the base of the portion fitting over the toe and joint

To make the toe loop, the practitioner cuts out a piece of rubber sheeting approximately 3½ in by 4 in This is shaped

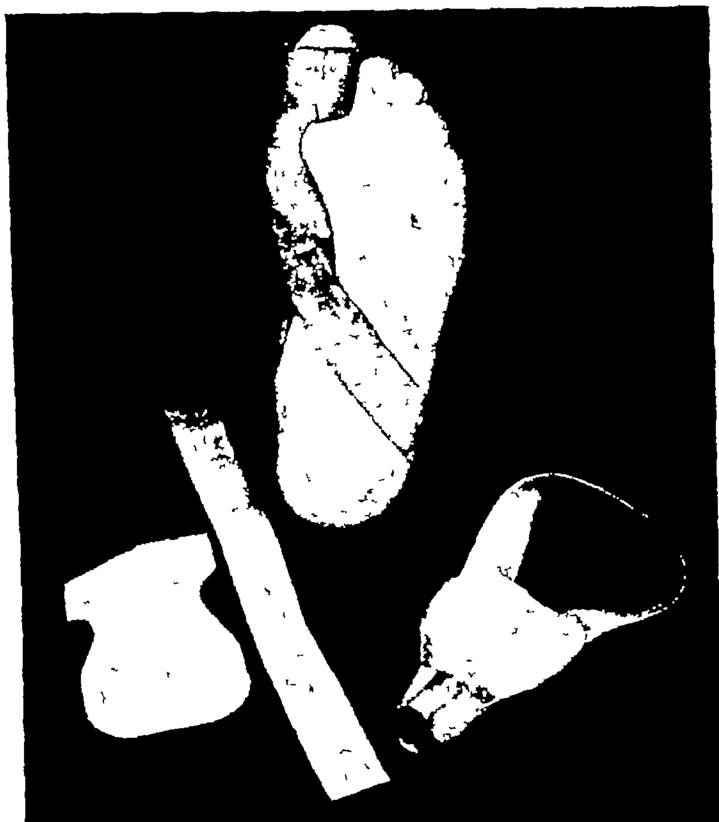


FIG 36

Hallux valgus traction sling

into an oval up to about three-quarters its length, where it splits into two short tail pieces (see Fig 36) When finished, this portion of the appliance should be 4 in long, 3 in across the broadest part of the oval portion and about 3½ in across the tail pieces A strip of rubber is now cut about 12 in long and 1 in wide This is the strip to form the *heel anchorage* To make up the appliance the following procedure is adopted.

CHAPTER V

STRIP RUBBER TECHNIQUES

APPLIANCES made by this method are simple in construction, involving the use of latex rubber sheeting, surgical sponge and rubber solution It is in the treatment of defects of the lesser toes in children that the author uses this form of corrective device extensively The remarkable effectiveness of many devices of the most simple character has greatly encouraged further exploration in this particular field

It is most difficult to retain either dressings or strappings of the orthodox materials on the feet of children for a sufficient length of time to be really effective This particularly applies to corrective strappings Strip rubber appliances, however, are not only easily applied, but may be removed for washing and are very durable in wear The materials involved are no more expensive than ordinary dressings, and considering the durability and effectiveness of the appliances, not to mention the all-important matter of hygiene, strip rubber devices achieve a substantial degree of economy

The author submits a series of examples of strip rubber appliances which have been extensively and successfully used

Hallux Valgus Traction Sling

A large number of cases of adolescent hallux valgus come before the chiropodist This particularly applies to the practitioner engaged in child health work with a Department of Education, although many such cases are met with in foot hospitals and private practice

While the device described is ideally suited as a medium of correction in children, it can also be applied with beneficial results in suitable adult cases The appliance is made in two portions, one forming a toe loop and cover for the joint, and a

underside The rubber strip is passed across the plantar surface of the foot, behind the head of the first metatarsal, obliquely across the dorsum of the foot, beneath the outer malleolus, round the heel and attached to a point posterior to the first metatarso-phalangeal joint The rubber should be brought round the foot with a sufficient degree of tension to exert the required traction on the fifth toe, bringing it into its corrected alignment. When the rubber strip has been brought round the foot to the final point of attachment, the surplus should be trimmed off and the ends of the strip secured in position This, of course, is not done whilst the appliance is on the foot and the rubber under tension It will be found necessary to cut out a shallow "U" piece in the toe loop where it impinges upon the web between the fourth and fifth toe This, like many other appliances by Budin, is an excellent device It has been used extensively by the author with conspicuous success (Fig 37) A modification of this type of appliance is to dispense with the heel anchor and substitute a metatarsal band This merely requires the strip, after being carried round the first metatarsal, to be taken across the dorsum of the foot, passed behind the fifth metatarso-phalangeal joint, brought across the sole of the foot and attached at a point behind the first metatarso-phalangeal joint This modified appliance may be worn in cases where the heel anchorage is not desirable Whilst satisfactory on the whole, this modified appliance is not quite so secure as that possessing the heel anchorage, as under certain circumstances the metatarsal brace may be dislodged, with a relaxation of tension upon the toe sling

Toe Sling and Brace of overlying Second Toe

This is a simple but effective appliance for cases of overlying of the second toe, for which purpose it proves particularly successful For the purpose of this appliance two strips of rubber, approximately ¾ in and 1 in wide respectively, are required The narrow strip should be about 7 in to 8 in long, and this is used for the toe loop This strip is looped over the toe, the two ends being overlaid on the plantar

The first piece is laid on the toe with the tail pieces forward and the front margin level with the end of the toe The tail pieces are now stretched round the toe to the outside and laid one over the other In stretching the tail pieces round the toe the degree of tension should be sufficient to grip the toe firmly When the tail pieces have been positioned to the practitioner's satisfaction, they should be marked, the opposing surfaces treated with rubber solution and secured one upon the other One end of the second piece which is intended for the heel anchorage is secured to the base of what now constitutes the toe loop To secure firmly about 1 in of overlap is necessary When this strip has been secured in position the appliance is placed on the toe and the heel strip passed round the heel, the end being brought into position alongside the first point of attachment Before securing the second attachment of the heel piece, the rubber strip should be stretched round the heel and held in position on the toe loop, the degree of tension being sufficient to draw the toe into a slightly varus position The surplus rubber is cut off, again allowing 1 in for overlap, after which the end of the strip is secured in position Perforations may be made in the toe loop with a leather punch to assist aeration of the toe

This appliance is suitable for continuous night and day wear, being removed at appropriate intervals for washing with a mild antiseptic solution

Traction Sling for overlying Fifth Toe

This ingenious appliance was devised by Budin and referred to in his book *Principles and Practice of Orthogidita* It consists of a strip of rubber ¾ in to 1 in wide and of a length ranging from 18 in to 24 in , the variations in width and length being accounted for by the difference in the size of foot to be fitted For instance, a lady's foot taking a size 5 shoe, generally requires a sling about ¾ in wide and about 18 in long

In making this appliance, the practitioner begins by making a 3-in loop at one end of the rubber strip, the loop, as in the former appliance, being secured by the use of rubber solution The loop is now placed on the toe with the short end on the

surface at the base of the toe The wider strip should be about 9 in to 10 in long, and is used for the metatarsal brace The object of this brace is to provide anchorage for the toe loop, to which it is attached by the use of solution The brace

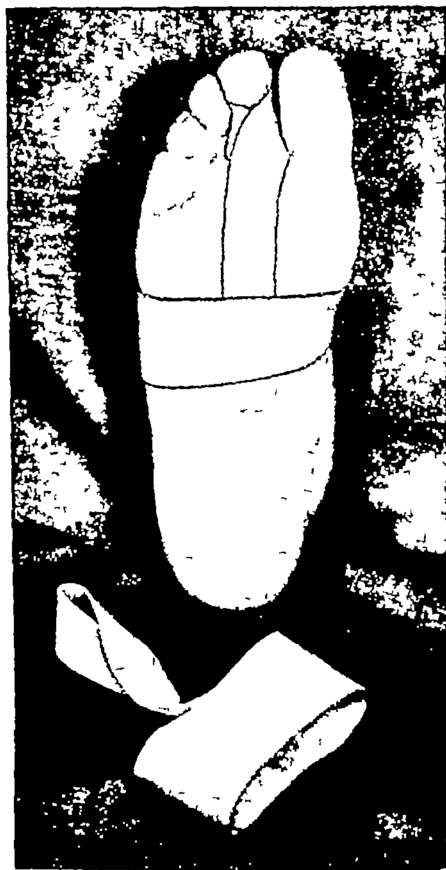


FIG 38
Traction sling for overlying second toe

is fitted round the foot posterior to the first and fifth metatarso-phalangeal joints (Fig 38)

Traction Sling for underlying Fifth Toe

A modification of the Budin traction sling can be made to provide traction in reverse for an underlying fifth toe

In this appliance the toe loop is placed on the toe so that

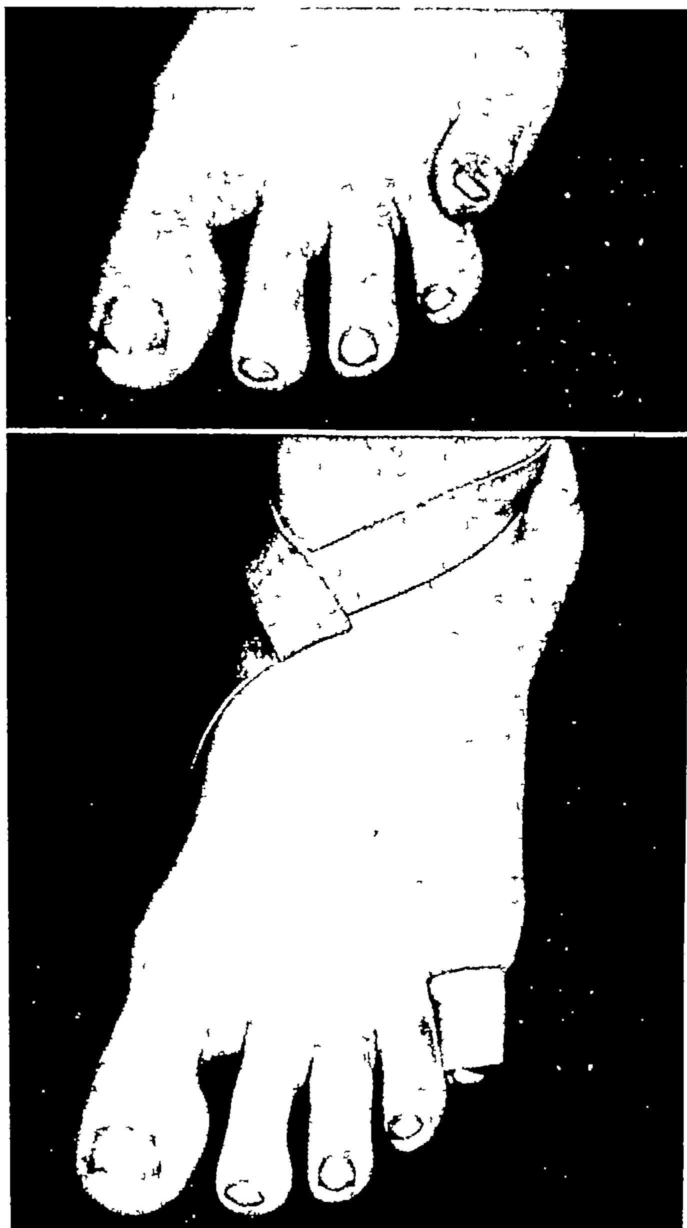


FIG 37

a Congenital overlying fifth toe *b* Correction of a congenital overlying fifth toe achieved by use of Budin's sling

This appliance is substantial and hygienic and its soft and resilient texture ensures comfort

Replaceable Shield for Sub-ungual Exostosis and Sub-ungual Heloma

For this appliance a piece of latex sheeting is cut approximately 4 in long to a shallow saddle shape The middle third of the posterior margin should form a bulge, the total width

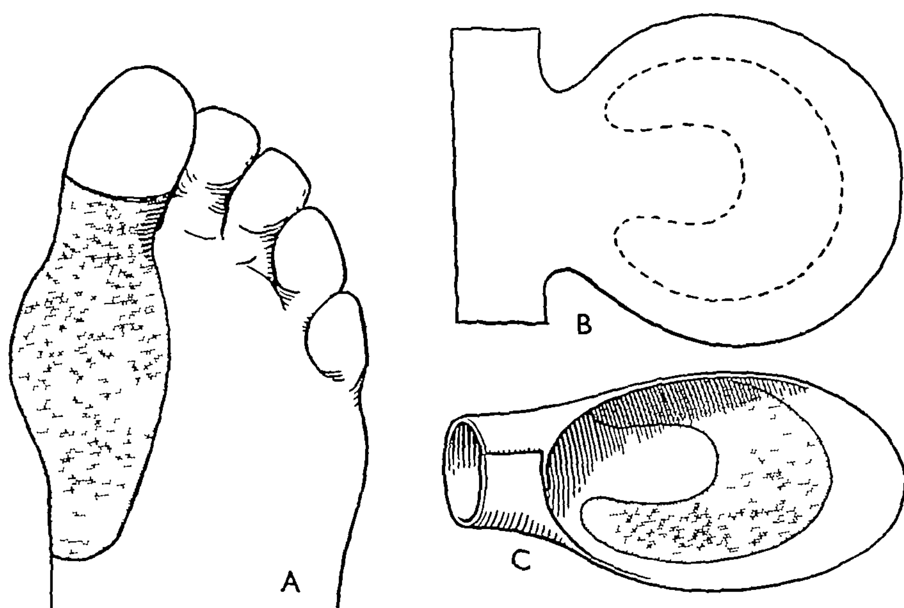


FIG 39
Replaceable bunion shield

at the greatest point being 1½ in The remaining two-thirds should form two tail-pieces about 1 in wide (see Fig 40)

A rectangular-shaped piece of sponge rubber of appropriate thickness is cut to a length of 1½ in and about 1¼ in. wide. The margin of one side of the pad is bevelled and a U-shaped cut-out made at one end about ⅝ in across and ½ in deep The pad is latexed on the bevelled side, as is also the middle third of the latex sheet When dry, the pad is fixed into position with the tail-pieces of the "U" fitting flush with the straight

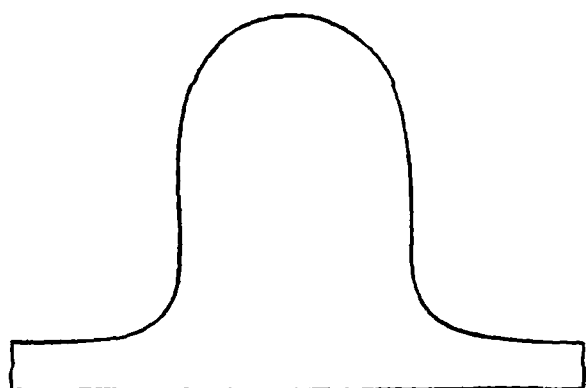
the rubber strip lies across the dorsum of the foot, passes behind the head of the first metatarsal, obliquely across the sole of the foot to the lateral side, whence it is carried round the heel beneath the malleoli and is attached at a point posterior to the first metatarso-phalangeal joint Whilst the writer has found traction slings very effective in overlying toes, clinical observations over a considerable period suggest that splinting and propping is more satisfactory in the case of underlying toes Peculiar features, however, do arise in all conditions when the alternative treatment proves the more successful, and it is for that reason that this device is brought to the practitioner's notice

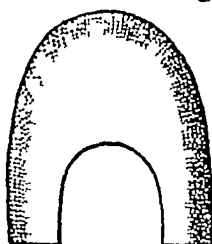
Replaceable Bunion Shield

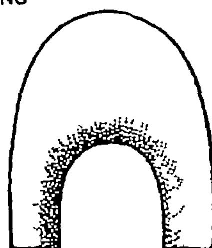
This is a simple device which will be found particularly useful where an inexpensive replaceable shield is required This appliance, however, does not lend itself to being worn without hose (Fig 39)

To make the appliance the chiropodist first cuts a piece of latex sheeting 3½ in by 4 in. This is then trimmed to an oval shape merging into two tail-pieces 1 in wide The approximate overall size will be length 4 in, maximum width of oval portion 2½ in, width across the neck 2 in, total extent of tail-pieces 3¼ in A piece of $\frac{3}{16}$ in sponge rubber is now cut into a crescent shield 2 in long, 2¼ in wide, aperture 1 in across The underside of the aperture is now bevelled, as is the outer margin of the shield Rubber solution is now applied to the outer side of the shield and to the oval portion of the latex sheeting When dry, the shield is fixed in position on the latex sheeting The two tail-pieces are now solutioned together with about ¼ in overlap, forming a toe loop The measurements given are for an average size of shield These, of course, can be modified to meet the individual case It is advantageous to leave the securing of the toe loop until the appliance can be tried on the actual patient, ensuring a satisfactory fit

so that it will conform to the contours of the exostosis The latex brace is now made $2\frac{1}{2}$ in wide and of sufficient length to encircle the tarsus and allow for a substantial overlap The







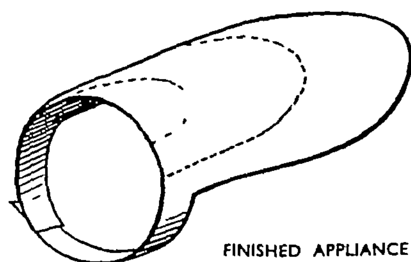


FIG 41

Protective shield for helomata of lesser toes

pad is affixed centrally on the brace, and the brace secured in the usual manner

Single Toe Prop

This type of appliance, whilst very simple in construction, has proved particularly useful as a corrective medium in young children. The soft sponge prop acts as a flexible splint in

edge of the latex sheet The tail-pieces of the rubber sheeting are brought together and secured, with an overlap of approximately ½ in

Shield for Heloma Durum of the Lesser Toes

A simple shield can be made in the following manner a small saddle-shaped piece of latex rubber sheeting is cut, the

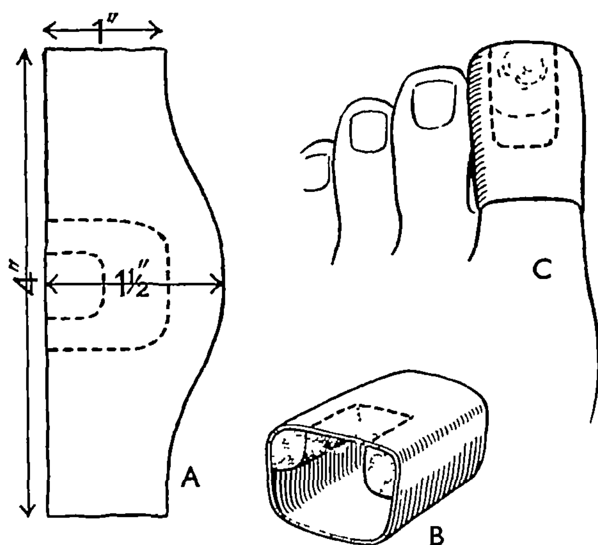


FIG 40
Replaceable shield for sub-ungual exostosis

saddle-shaped portion being 1⅛ in deep and ⅞ in across the two tail-pieces, each of a length of ⅝ in and about ⅛ in wide. A sponge crescent is cut of slightly less dimensions than the saddle-shaped portion of latex sheeting, its upper margin bevelled, and the cut-out bevelled on the underside The shield is fitted into position and a tail-piece is secured (Fig 41)

Replaceable Shield for Cuneiform Exostosis

This useful device consists of an oval shield, approximately 2½ in by 2 in, with a central aperture The shield is bevelled on the upper margin and the aperture on the under margin

A simple appliance can be made consisting of a strip of surgical sponge about $\frac{3}{16}$ in thick and an appropriate width to fit into the crooks of the toes As the toes shorten towards the lateral side of the foot, the pad should be correspondingly

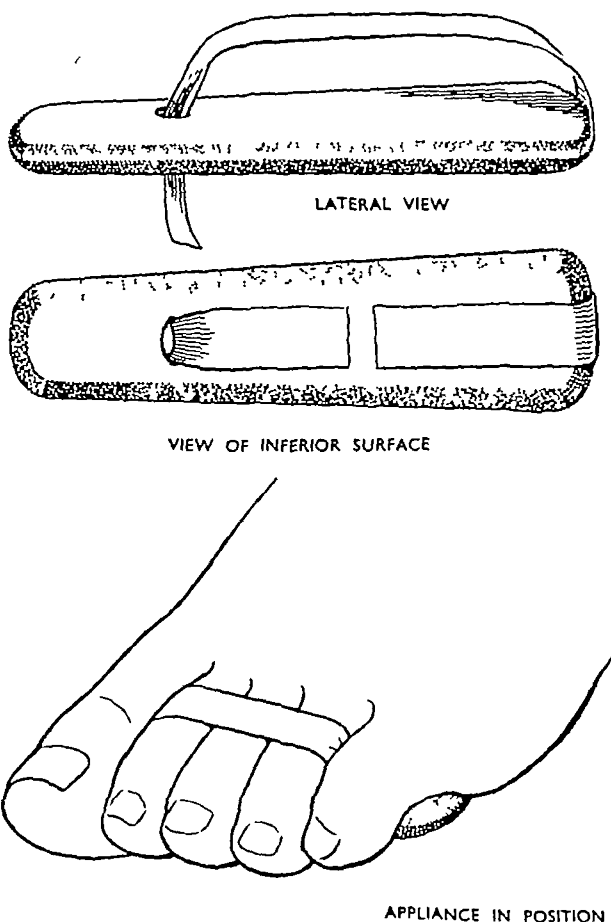


FIG 43

A plantar prop so designed as to include the fifth toe

graduated in width, narrowing gradually from the second to the fifth toe It is advisable to cut and shape the prop to the actual foot of the patient In this way accuracy in length and width are ensured and any special peculiarities of the foot can be taken into account. The prop is secured under the toes by a rubber band, and if it is desired to involve the fifth toe

conjunction with the latex brace passing round the toe It assists in levering an underlying toe back into its correct alignment, whilst the brace, in conjunction with the prop, holds the toe straight Care should be taken in fitting the loop or brace. Tension should only be sufficient to achieve its object If the toe becomes blanched when the appliance is in position, it is an indication of undue constriction, and the loop should be

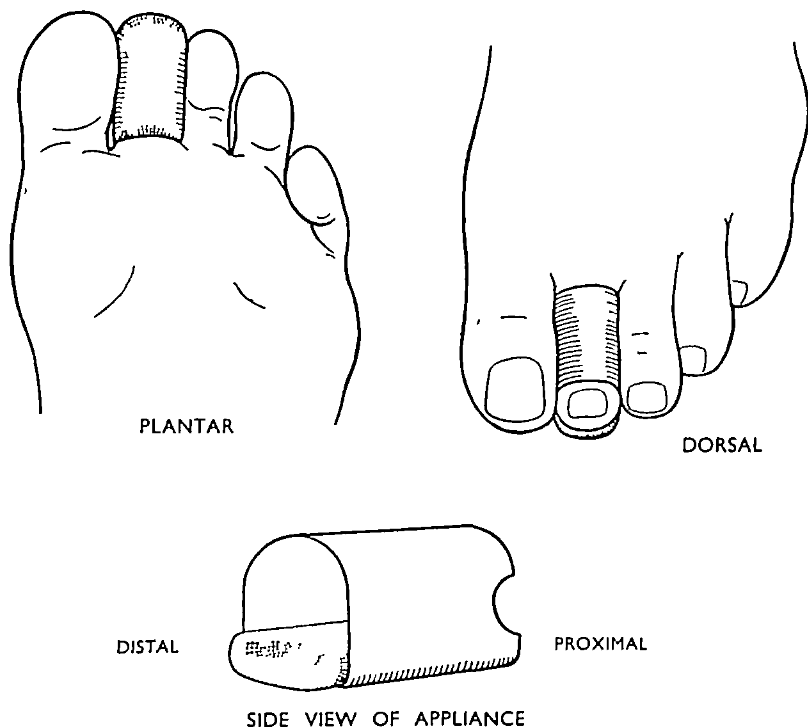


FIG 42
A single toe prop

detached and slackened The rectangle of sponge should extend from the end of the toe to its base The brace should be of similar width, but U-shaped cut-outs at the posterior margins will be necessary to avoid impinging upon the webs of the toes (Fig 42)

Plantar Prop

Whilst in adults it is not usually satisfactory to extend a plantar prop to the fifth toe, it is possible to do so in the case of children when natural form shoes are worn.

prop should fit on the plantar aspect of the toes, and the anterior straight edge of the D-shaped pad immediately behind the inter-phalangeal joint on the dorsal aspect

Strip rubber appliances are simple to make and quite inexpensive, and because of this can be substituted for ordinary padding and strapping in many instances without additional cost to the patient

The author feels, however, that to cover all pads and props with chamois or other suitable leather will be well worth the practitioner's trouble and the slight additional expense involved

LATEX LACE

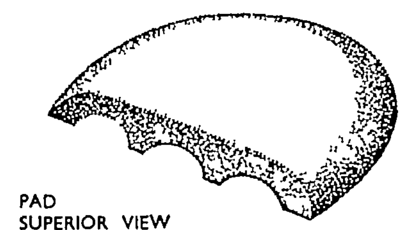
For many of the appliances described under strip rubber technique, latex lace or "Lastonet" is very pleasing as an alternative This material is woven from latex yarn and has a very open mesh, being very elastic, it moulds itself closely to the contours of the foot and can be used to exert traction for corrective purposes Its particular virtue is that the open weave of this material allows for adequate aeration of the part.

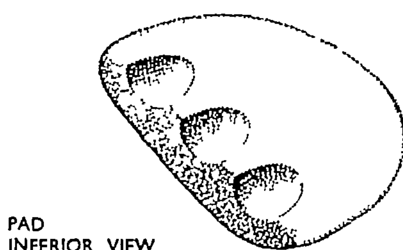
Experience has taught that it is advisable to use double thickness for most appliances, particularly in making traction slings, as single thickness is hardly strong enough

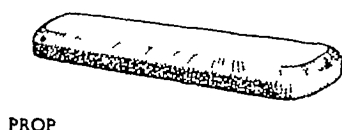
Metatarsal Appliances

For the making of a metatarsal pad and brace this material is most suitable, particularly when the brace is made from a double thickness of the material It has, however, been noted that in wear, toe loops of this material tend to chafe the interdigital aspects and webs of the toes It would therefore be advisable when making a metatarsal pad with forward extension and toe loops to make the toe loop of wash-leather, using the latex lace for the metatarsal brace only Metatarsal appliances can be made by using a double thickness of the material and stitching to form a pocket for the sponge pad

an aperture may be made in the prop with a rubber punch at a point approximating to the fourth interdigital space The band may be passed down between the fourth and fifth toes and through this aperture and attached to the outer surface of the prop It is found that by passing the band round the fourth toe rather than round the fifth the appliance is more firmly secured and not so easily dislodged as if passed round the fifth toe Also, the tendency for the fifth toe to be pulled under the fourth by the traction of the band is thus avoided (Fig 43)







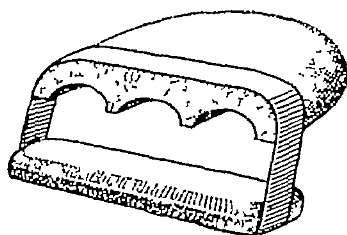


FIG 44
Dorsal pad and plantar prop

Dorsal Pad and Plantar Prop

This appliance consists of a D-shaped pad of sponge rubber of appropriate size and thickness, $\frac{3}{16}$ in to $\frac{5}{16}$ in being usually suitable, and a plantar prop of corresponding length The two pads are joined together by a rubber band passing round the underside of the plantar prop and along the anterior straight edge of the D-shaped pad (Fig 44) The D-shaped pad should have a broad bevel round the posterior margin, merging into an abrupt bevel $\frac{1}{2}$ in from the ends, where they join the anterior margin

This appliance is more satisfactory when only involving the second, third and fourth toes When placed in position the

medial sides round the heel to the mid-tarsal area on the lateral side, with an anchoring brace round the tarsus

The simple heel loop has been found very satisfactory, with the advantage that the appliance is invisible in wear (Fig 45)

Lesser Toe Slings

The sling for overlying fifth toe can be made on the "Budin" principle, by making a toe loop of chamois leather and the sling of Lastonet

In a similar way the sling and brace for overlying second toe can be made from this material

Hallux Valgus Appliances

A simple traction sling for hallux valgus is made by forming a toe glove of a double thickness of the material with a heel sling attached A more ambitious form of this appliance is made by taking a cast of the great toe, including the first metatarso-phalangeal joint, and moulding chamois leather

FIG 45
Left—Metatarsal pad and brace Right—Hallux valgus traction sling

over it in the same way as when making a latex bunion shield The leather can be reinforced with fabric and covered with an outer leather The toe glove is aerated by numerous perforations made with a leather punch, after which a traction sling of Lastonet can be attached An alternative method of slinging may be used by carrying the elastic brace along the

in the shoe by general diffusion of weight over the whole plantar area

As this appliance is made on a plaster cast of the foot, it fits snugly to the tissues, gripping the foot firmly So accurately does the appliance conform to the foot that this soft, resilient device has repeatedly provided the only solution to many post-operative problems In cases coming within the aforementioned category, this appliance is made with a lining of fine surgical chamois leather and padded with soft sponge rubber The outer cover may also be chamois leather or a fine basil split or glove kid In the case of the amputation of all or any of the appendages, a frontal extension of soft sponge rubber can be fitted to the moccasin and shaped to give a general outline of a perfect foot when a stocking is worn over it (Fig 46) The fitting of a forward extension of this nature also enables the fore part of the shoe to be filled In this way unsightly creases on the vamp of the shoe are prevented, and also a greater degree of stability is achieved Furthermore, a shoe which looks and feels normal eliminates a tendency to self-consciousness (Fig 47)

A fine piece of chamois leather is placed over the plantar surface of the cast, bringing it over the back of the heel up to the required depth and over the ends of the toes on to the dorsum of the foot The leather is now brought up the side of the foot, which will result in the formation of a pleat at each corner The pleats should be cut away and the inner edges latexed When these are dry, they should be nipped together (Fig 48), trimmed flush and secured with tapes of cotton bandage In this way the foundation of the moccasin has been created When nipping the edges together, care should be taken to see that the moccasin fits tightly on to the cast, particularly round the upper margin The next stage in this process is to coat the whole moccasin with latex and allow to dry Drying, of course, can be accelerated if the cast is held in front of a radiator Care, however, should be taken to avoid scorching In applying this first coat a soft brush should be used and the latex coating applied very lightly and thinly

CHAPTER VI

MOCCASIN TECHNIQUES

THE practitioner meets with cases in which some congenital or acquired deformity of the foot so upsets the normal distribution of weight-bearing as to cause abnormal pressure areas which are extremely painful Such cases, when they present themselves for treatment, are of a chronic character Not infrequently traumatic ulcers result from continuous pressure and irritation over callous formation

Deformities resulting in lesion of this type arise in cases of spastic paralysis, spina bifida and chronic rheumatic conditions

Great accuracy in the fitting of any protective device is required, and anything that is liable to become dislodged, even to the slightest degree, will be doomed to failure It was in an endeavour to overcome this particular problem that the author carried out experimentation with various forms of permanent padding The outcome of this line of investigation was what is best termed a moccasin appliance, for the simple reason that it is merely a soft moccasin slipper made from chamois leather, surgical sponge and latex rubber Some degree of body can be given to the upper by using a layer of cotton bandage between the leathers

To make a device of this nature it is necessary to take a cast of the whole foot, and a deep slipper cast will enable the chiropodist to obtain a positive cast adequate for his requirements The case sheet should contain the fullest information on the varying degrees of pressure at different points, any peculiarities in angulation, inversion, eversion, hyperextension, etc This information is essential to enable the chiropodist to make an appliance which will not only relieve pressure from painful areas but will, as far as possible, stabilise the foot

This somewhat light and delicate method of applying the latex is necessary to avoid it soaking through the chamois leather to the inside and spoiling, to some extent, the effect and appearance of the inner lining Two or three further coats may now be applied liberally, as, providing the first coat is thoroughly dry, it is not possible for the liquid to soak



FIG 48

Trimming the seam flush prior to taping The taped seam can be clearly seen on the cast in the foreground

through, the first coat having formed a thin protective skin When the final coat of latex thoroughly dries, the practitioner should prepare the surgical sponge protective padding This soft resilient material should fit very close round the various prominences, constituting pressure points Padding should also be applied to the concavity of the long arch, the object of the padding being not only to remove pressure from the painful areas by padding round them but to apply the padding in such a way as to diffuse the pressure over the whole plantar



FIG 46

Right—Latex foam built on to the forepart of the moccasin prior to the final shaping Left—Foam extension scoured to shape



FIG 47

The cast and the completed false toe moccasin

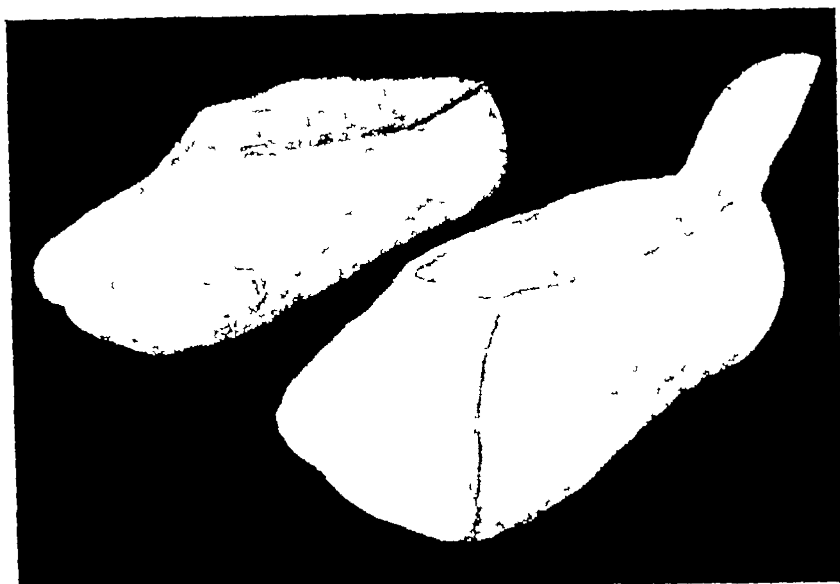


FIG 49

Finished moccasin appliance, non-golosh type



FIG 50

Fitting of the golosh type outer leather to a moccasin appliance

area The chiropodist should, as far as possible, aim at stabilising the foot in the shoe and, as a consequence, some degree of wedging may be necessary The padding should be just adequate to relieve pressure and no more, and should be trimmed in such a way as to leave a clean uniform under surface The insulation is completed by a final sole of thin sponge fitted over the whole plantar area It is usually found advisable to reinforce the wash-leather constituting the upper of the moccasin to prevent it becoming stretched and mis-shapen in use This is done by applying one or two layers of cotton bandage which have, as previously described, been treated with latex The moccasin is now ready for the final cover, which can be also of chamois leather or of very fine basil split, which presents a smooth, soft surface not so easily soiled as the former leather The outer cover should be cut generously and applied in the same manner as the first leather cover, except that whilst the former is stretched tightly on to the cast, this should be laid gently over the appliance and not stretched on The reason for this is that when it is stretched on it will tend to contract when the appliance is removed from the cast and so distort it The only part where stretching-on is advisable in this outer cover is at the point representing the actual upper margin of the cover The edges which have been nipped together at the four corners can be trimmed flush with a pair of scissors and will remain perfectly secure The joints will be very neat in appearance (Fig 49)

The moccasin is now gently removed from the cast, this will be somewhat difficult as the moccasin will naturally be a tight fit After it has been removed, however, the upper margin of the appliance can be trimmed and shaped

Golosh Type Upper

The outer cover may be cut as a U-shaped piece to fit over the front of the cast and along the sides When this has been moulded on and the ends nipped together at the back, it should be moulded on to the plantar surface and the surplus skived away

The appliance is completed by fitting a sole of a more



FIG 49

Finished moccasin appliance, non-golosh type



FIG 50

Fitting of the golosh type outer leather to a moccasin appliance

substantial leather, sheepskin being very suitable The finished appliance resembles a slipper with a golosh upper (Fig 50)

The moccasin appliance can also be processed by the dipping method, using an accelerator When using this technique it is advisable to seal the top edges of the leather with adhesive tape so as to prevent the latex milk rubber finding its way between the leather and the cast and thus spoiling the lining As in the case of other latex shields in which the dipping method is used, a coating of rubber solution should be applied to the leather before dipping is commenced Three to four coats of latex should be applied before the padding is placed in position, after which a further three or four coats will complete the appliance with the exception of the outer leather If the appliance is to be worn in a strong shoe, it can be strengthened by additional coats of latex The secret of success in this type of appliance is to provide just the right degree of resilient support to prevent impingement upon the pressure areas whilst at the same time providing a slight amount of general insulation, achieving this combination with a minimum of bulk

Moccasin appliances can be modified in many ways to meet individual cases, in their application the practitioner will find ample scope for his ingenuity

The author has found that in some cases where the moccasin is designed for the protection of lesions or painful areas on the plantar aspect only, that it is an advantage to cut away the upper over the toes, leaving only a collar round the instep. The modification makes the appliance much less bulky in the forepart, whilst the combination of the collar round the top ensures that it is retained securely in position on the foot

Another improvement is to make numerous perforations in the upper These holes should be made with a leather punch, and should be so numerous as to give an openwork basket effect The aeration of the foot will be greatly improved by this procedure In some cases it has been found necessary to make an aperture for the great toe, several moccasins of this type have been successfully fitted In some cases the in-

corporation of dorsal padding has been successfully carried out In several cases a tab was fitted at the back of the appliance to assist in pulling it on the foot.

The author has numerous cases on record in which this type of appliance has been the means of solving a long-standing problem Some examples have been selected and included in this volume, with appropriate clinical photographs.

CHAPTER VII

CORRECTIVE SURGICAL INSOLES

IN giving consideration to defects of the longitudinal arch it would be as well to contemplate briefly the structure and function of the feet, with special consideration of the arches If a pedograph is taken of a patient standing with the feet parallel, the footprints show only the heels, the metatarso-phalangeal areas, and the lateral borders The medial borders of the prints appear concave because the inner longitudinal arches are not in contact with the ground Ellis informs us that the legs and feet do not constitute two separate pillars, but are two halves of a divided pedestal, each being complementary to the other When standing we are supported on the outer rim of a more or less complete circle This outer rim provides the static support, and the raised, domed inner portion forms the lever This strong resilient arch provides the base from which the body is propelled, whilst the outer rim provides a stable area of support In 1938, when dealing with this subject, Lambrinudi stated, "the outer part lies flat on the ground, giving a big weight-bearing surface and providing stability and balance with the aid of the fourth and fifth toes It is essentially a balancing organ, whereas the inner portion is essentially a lever "

If the leg and foot were stripped of its soft structures down to the ligaments, it would be seen that the foot is not only arched longitudinally, but that there is also a deep transverse arch, making a deep depression running from the anterior border of the calcaneum to the heads of the metatarsals This transverse arch is deepest under the cuneiforms and cuboid bones Bridging this from side to side are the strong tendon slips of the insertions of tibialis posticus and peroneus longus, the former running from the inner side and the latter from the outer side Whilst these are intact the transverse arch cannot

be flattened This is particularly applicable to the peroneus longus, which assists materially in maintaining the transverse arch by pulling the internal cuneiform and first metatarsal towards the cuboid Whilst the transverse arch is maintained in this manner it is impossible to collapse the long arch The muscles running from the leg to the foot provide the active support of the arches They act as slings on each side of the foot, holding up the centre of the long arch The peroneus longus does this on the outer side and the tibialis posticus on the inner side They are further assisted in this function by the flexor hallucis longus, which passes along the sole of the foot like a bowstring, and also by the flexor digitorum longus, which passes forward along the plantar surface of the foot.

When considering the bone structure of the arches of the foot they should not be contemplated as an architectural arch locked by a keystone at the summit but as a series of segments arranged in the form of a concavity retained in their relative positions by strong bands of fibrous tissue These allow limited movement at the articulations and provide an appreciable degree of flexibility in the foot as a whole The passive support of the arches of the foot is brought about by the peculiar shape of the bones and the strong ligamentous bands which retain them in position, while the active support is provided by the muscles These give that controlled resilience found in healthy feet Thus the feet are designed to provide shock absorption and leverage for propulsion

WEIGHT DISTRIBUTION

When a person with normal legs and feet stands in an erect position, body weight is transmitted in definite proportions to the base of the calcaneum and the heads of the metatarsals By means of the staticometer, Morton demonstrated that the weight was distributed half to the calcaneum and half to the metatarsals, where the first metatarsal accepts twice the load of the remaining four It should also be noted that the second, third and fourth metatarsal heads depress on weight-bearing

taking their proportionate share of the load The lateral arch is similarly depressed, forming the outer border of the foot into the static buttress or outer rim of the pedestal as described by Ellis and Lambrinudi The long and short plantar ligaments reinforce and control the lateral segments of the foot, ensuring its stability

The medial arch, which constitutes the highest part of the concavity of the long arch, is designed to provide some degree of flexibility It should be understood, however, that the range of depression is limited by the ligaments controlling the bones and is only sufficient to provide the necessary shock absorption That this restricted degree of depression of the medial arch does take place has been fully demonstrated by the radiologist At a lecture given in December 1948 by Dr R G Ollerenshaw, two radiographs of a normal foot were shown, one non-weight-bearing and the other weight-bearing Lines marked at the anterior and posterior extremities of the foot showed that on weight-bearing the arch was slightly depressed and the foot lengthened appreciably The degree of depression of this medial arch in the sound foot is not sufficient to affect the normal stability, since, when the natural limit of movement is reached, the ligaments prevent further depression, and the foot under static pressure becomes a rigid structure with well-balanced weight distribution

STRUCTURAL AND POSTURAL STABILITY OF THE FOOT

The structural stability of the foot is provided by the bony architecture of the foot as previously outlined, maintained by the peculiar shape of the bones retained in their compact formation by binding ligaments The postural stability is maintained by a combination of the action of the intrinsic muscles of the foot and the muscles of the leg, which maintain a constant balance of the tibia in relation to the talus, and thus body weight is transmitted in correct proportions to the bearing surfaces of the foot This is ensured by the muscle tonus and the balanced action of antagonistic muscle groups.

Thus we have a stable, rigid base provided by the bony architecture, and postural balance by muscular control

FACTORS AFFECTING THE STABILITY OF THE FOOT

The stability of the foot may be undermined by defects in the bony architecture, which may be congenital or the result of disease or trauma

Some Congenital Defects in the Bony Architecture

Developmental defects in one or more bones of the foot may seriously upset its normal architecture, resulting in malfunction and instability

Short First Metatarsal

This was first stressed by Morton, who stated that a short first metatarsal bone causes the second to act as the principal leverage member The stresses converge upon the base of the second metatarsal and are transmitted by it to the ground He goes on to inform us that under the increased amount of function the shaft of the second metatarsal becomes widened and hypertrophied The effects here are threefold First, a postural fault will arise owing to the tilting inwards of the medial arch until the head of the first metatarsal becomes weight-bearing This upsets weight distribution through the foot, and undermines the normal triangle of stability Ligaments are strained and a process of pronation of the foot results Secondly, the abnormal weight-bearing of the second metatarsal will result in weakness of the anterior metatarsal region, causing a dorsal subluxation of the second metatarso-phalangeal joint, with painful callosity under the head of the metatarsal Thirdly, there may be a traumatic synovitis of the second metatarso-cuneiform joint as a result of strain and irritation.

Hypermobile First Metatarsal

In this condition, which may be congenital or acquired, the stability of the foot will be affected by the elevation of

the head of the first metatarsal on weight-bearing This has an effect similar to that of a short first metatarsal, resulting in a falling over inwards of the medial arch A factor which should also be considered is not essentially an elevation of the head of the metatarsal, but rather a depression of the base in association with a weakness of the retaining structures of the first metatarso-cuneiform articulation

Metatarsus Primus Varus

This is a further weakness of the architectural structure in which the first metatarsal is deviated medially at an abnormal angle There is usually also a marked widening of the articulation between the first and second cuneiforms Weakness of the ligaments is usually associated with metatarsus primus varus, producing the condition of hypermobility of the first metatarsal segment with the inevitable undermining of stability and the clinical feature of some degree of pronation

Other osseous factors are knock-knee and bow-leg, either of which cause a mal-direction of thrust through the leg on to the foot, upsetting the normal weight distribution

It will be noted that in all architectural defects ligamentous strain and weakness is inevitable

Os Tibialis Externum

This is a separate ossification of the tuberosity of the navicular According to Lake, this structural defect occurs in 10 per cent or 12 per cent of people, and causes weak and painful feet In this condition the inferior calcaneo-navicular ligament may well be involved, and as a result of the weakening of the attachment of this ligament, posture and balance may be affected, involving the medial arch

MUSCULAR AND LIGAMENTOUS STRAIN

Whilst the defects in the osseous structure of the foot almost inevitably undermine the stability of the foot, it should be realised that weakness of ligaments and muscles will affect the stability of a foot even though it is perfect in its bony architecture The support of the dynamic foot is vested in the

muscles, and if these are healthy a degree of contractility is always present, even when the foot is at rest This degree of contractility is known as muscle tonus Should the muscles be weakened by illness or disease, muscle tonus will be lost, their function as supports will be impaired, and in proportion to the degree they are affected, strain will be placed upon the ligaments Continued passive strain on the ligaments will result in their becoming gradually stretched, allowing a range of movement at the joints beyond normal Thus weakness of muscles will impair postural stability

Summary —The factors responsible for the maintenance of a healthy foot are a perfect, architectural structure with the arrangement of bones well secured by the ligaments and actively supported by muscles These provide a firm outer buttress, a resilient medial arch and lever, with correct distribution of weight ensuring structural and postural stability in both the static and dynamic foot

Congenital defects in the osseous architecture of the foot and leg, or muscular weakness, will ultimately affect the stability and function of the foot Whilst in a number of cases defects in the bony structures of the leg and foot are responsible for postural instability with varying degree of flattened or pronated foot, by far the greater proportion are acquired as the result of external influences These include such factors as general debility, as a result of illness which may or may not confine the patient to bed for a long time, passive strain, as the result of long periods of standing in one position, e g shop assistants, excessive weight-bearing, people carrying heavy loads, pregnancy Anæmia in a child during the growing period often results in flabby, undernourished muscles which are not able to perform adequately their duty of providing active support for the arches The patient confined to bed suffers from atrophic muscles which are not able to provide the necessary support when he is up and about again In the case of the shop assistant, continued passive strain results in muscular fatigue or atonia (loss of muscle tonus), whilst the person carrying heavy weights taxes the muscles beyond their normal capacity, inducing muscle fatigue and atrophy

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will be everted, a marked bulge in the region of the navicular will be observed, and the tendo Achillis will show an outward swerve Another factor is the plantar flexion of the great toe, caused by an endeavour to regain the stability which has been lost as a result of the hypermobile or short first metatarsal In the completely pronated foot the lateral border is no longer weight-bearing and will be raised

Contra-Lateral Wedging

In 1946 W Sayle-Creer stated, "most cases are not flattened, i e badly shaped feet, but are everted, valgus, over-balanced or pronated feet, i e feet whose posture is wrong The treatment required is to restore the posture or balance rather than a hypothetically dropped arch" He also informs us that in this pronated foot the great toe acts as if it were taking over the support of the inner border of the foot because the first metatarsal is incapable "You will often see an over-acting anterior tibial muscle tendon standing out too clearly (which only shows that the trouble is not primarily due to a weak anterior tibial muscle)" A test was then suggested in which the heel is grasped from the back with the thumb on the inner side and the index finger on the outside The heel is gently but firmly pressed into slight inversion, when the medial arch will be restored This experiment should always be carried out with a moderately relaxed foot

Treatment of Pronated Foot

In 1937, in the *Journal* of the British Association of Chiropodists, Mr Sayle-Creer described how he arrived at his own particular method of treating pronated feet by the use of outside sole wedges He states that as a house surgeon to an orthopædic department "it fell to my lot to see both severe mobile and rigid forms of flat foot manipulated and put up in plaster of paris I was taught to invert the heel and apply the plaster on the leg and heel in this position As soon as this portion was set hard we 'untwisted' the forefoot, that is, we everted the forefoot and completed the plaster on what was now a beautifully shaped foot with a good longitudinal arch

FLATTENING AND PRONATION OF THE FOOT

Pronated Foot

The effect on the postural stability of the foot in the case of a short first metatarsal and a hypermobile first metatarsal have already been mentioned The foot falls over inwards until the head of the first metatarsal becomes weight-bearing In



FIG 51
Mobile pronated feet of a young adult

such cases the tarsus does not flatten, but topples inwards as a unit (Fig 51) The effect of this is to place an abnormal strain on the inner capsule of the ankle joint and the internal lateral ligaments A radiograph (posterior view) of such a case will show eversion of the calcaneum in relation to the tibia, the extent being related to the degree of pronation The tuberosity of the navicular will also be noted to be very prominent In the case of the hypermobile first metatarsal and metatarsus primus varus, the shaft of this bone will be shown parallel to the ground If the patient were to stand on a table with his back to the practitioner it will be noted that the foot

the corrected position and be light, resilient and strong, with a reasonable degree of serviceability.

Flattened Foot

In addition to the pronated foot arising from some architectural defect in the osseous structures, or instability of the first metatarsal segment, a proportion of flattened feet are met with on which a general sagging of the arch structures has taken place. In severe cases of this flaccid type of flattened foot the neck of the calcaneum will be depressed to a marked degree and an obvious gap will be noted in the calcaneo-cuboid articulation. This flattened foot is met with in cases where the supporting muscles have been very considerably weakened by some serious illness. The writer has seen a number of cases during the examination of the feet of adolescent school children. In such cases the general physique was poor, with muscles underdeveloped and flabby. As in the case of pronated foot, intermediate stages of the condition will be seen. There will also be cases in which a combination of some degree of flattening and pronation occurs. This flattening out of the bony arch is the result of continued strain on the passive supporting structures which are unaided by debilitated muscles. The corrective appliance for either the flaccid flattened foot or the pronated foot aims at reforming the foot into its normal contours. This is achieved in the former case by supporting the bones of the foot and holding them in correct relationship to each other, and in the latter, by inverting the heel and everting the forefoot, thus reforming the long arch. In either case the re-establishment of the normal bony architecture of the foot results in a regaining of correct weight distribution and structural stability. Postural stability will eventually be established when remedial exercises and the exercise resulting from use in its corrected position have succeeded in developing muscle tonus and balance in the foot and leg. On reflection, it will be realised that in achieving such an appliance the important factors are design and materials.

In view of the characteristic individuality of feet, it was obvious that the only sound basis from which to start was with

This set me thinking, until I realised that if the severe cases needed an everted forefoot so must the simple case, so from then on I discarded the inner sole wedge (Thomas wedge) and either left the sole level or else wedged the outer side" In the case of the hypermobile first metatarsal, it is advisable in carrying out the experiment for reforming the long arch not only to invert the heel but to depress the head of the first metatarsal In clinical practice the inside of the heel is wedged to hold the heel upright or slightly inverted This wedge prevents the heel from sagging into eversion The outside sole wedge assists in everting the forefoot and depressing the head of the first metatarsal It should be noted that after wedging, the plane or level of the road surface is altered As a result the shoe will wobble when placed on a flat surface because the wedging of the shoe has caused it to be twisted It should therefore be untwisted until its stands firmly The degree of wedging must be determined in each individual case It is also necessary to watch the reaction after wedging and make modifications accordingly

The writer carried out this method of wedging over a number of years This was done in conjunction with progressive remedial exercises, and proved to be a great advance on corrective measures previously used In the course of clinical observations over a considerable period of time it was noted that in many of the cases the loose fitting of the shoe heel allowed the heel to sag into eversion despite the heel wedge It was also realised that the considerable variation in wedge thicknesses required resulted frequently in a system of trial and error, necessitating a series of shoe alterations which caused much inconvenience by repeated visits to the shoemaker I felt, therefore, that the interpretation of this excellent system of correction in a form that would eliminate these defects was very desirable Such an appliance would be required to hold the foot firmly in the corrected position When reflecting on the variety of foot types and the varying degrees of elevation of the medial arch, I realised that the appliance must reform each foot to its own natural contours The device should hold the foot firmly but comfortably in

anterior margin ending just posterior to the heads of the first and fifth metatarsals.

The principle upon which the insole works is as follows: As the insole has been made upon a cast of the corrected foot, the foot when placed upon the appliance must reform to the corrected contours. The heel is guided into its proper seating in the cupped heel by the lateral flange which retains the heel firmly in position The flange is strongly reinforced, particularly at its outer base, to enable it to resist the thrust of the calcaneum as the foot bears down upon the anterior platform of the appliance. The medial flange, the twist of the plane of the upper surface of the insole and the extension of the lateral flange correct the forefoot In this way the body-weight acts as a corrective medium as it is transmitted through the weight-bearing foot, which is reformed If the cast of the corrected foot is held on a level with the eyes, plantar surface uppermost and with the heel to the rear, it will soon be seen that the inversion of the heel has resulted in it being on a different plane to the anterior weight-bearing surface (the ball of the foot) The plantar surface of the heel inclines upwards to the lateral side, as a result of which an insole made to the cast without some adjustment could not be stabilised in the shoe It is necessary, therefore, to build up the medial side until a horizontal plane corresponding to the anterior-bearing surface is achieved An appliance so wedged will be found to stand firm and stable on a flat surface (Figs 52 and 53)

Materials

In giving consideration to materials for the making of the corrective surgical insole, the writer had in the forefront of his mind the qualities required of the appliance, that is faithful reproduction of the contours of the cast, strength, resilience and lightness. After considerable experiment and much enquiry, particularly within the shoe industry, a satisfactory combination of materials was evolved

A soft natural finish sheepskin was found ideally suited to form the foundation of the appliance. The leather being very soft and pliable could be stretched over the cast and moulded

a cast of the corrected foot Casting for this purpose by the negative and positive plaster method was neither convenient nor practical

Slipper Casting for Correction

Slipper casting was found to be reasonably suitable These casts can be taken as advocated by Nelson, the patient lying face downwards on a plinth with the legs supported in a semi-flexed position Nelson claims that the mobile pronated foot regains its normal contours in that position The casts can be taken, however, quite successfully by sitting the patient in a chiropody chair The limb should be supported in a semi-flexed position by an assistant When the plaster bandage has been applied, the foot should be remoulded into a corrected position by inverting the heel, everting the forefoot and at the same time depressing the head of the first metatarsal It is advisable to press a flat surface gently against the plantar surface of the heel, otherwise the impression of the non-weight-bearing heel will not be found suitable in the finished surgical insole

CORRECTION OF MOBILE PRONATED FOOT BY SURGICAL INSOLES

The writer claims that after numerous experiments he succeeded in designing an appliance which conformed to all the requirements both in its ability to reform the foot and maintain it in correction It also combines lightness and resilience with strength The appliance is an insole designed with a cupped heel which extends upwards on the lateral side of the calcaneum as a flange which is reinforced to form a strong buttress On the medial side a conventional flange extends to beyond the navicular where it is swept in to follow the shaft of the first metatarsal Returning to the lateral side, it should be noted that this extends as a shallow flange along the lateral border, tapering away almost to nothing behind the head of the fifth metatarsal The appliance extends to the conventional length of the ordinary arch support, its

to every protrusion or depression A cellulose cement made by Pochins proved to be the most satisfactory plastic material Being easily applied with a brush, it could be made to flow readily by adjusting its consistency. This is done by adding suitable quantities of the solvent supplied for use with the cement I had already experimented extensively with cotton bandage laminations in conjunction with latex milk rubber in the making of the soft sponge palliative insoles, and combined these with tempered steel springs and blocked leather I decided, therefore, on the use of this material as a means of reinforcement I made experimental insoles with longitudinal and transverse strips, with and without interlacing, also introducing the bowstring principle The results of these experiments was that there appeared to be little variation in the degree of strength achieved in these methods of laminating. I finally arrived at a method of longitudinal strengthening that has proved quite satisfactory, as any tendency towards shrinkage in the cotton material helped to strengthen the long arch by countering any tendency to flattening under constant weight-bearing In addition to the cement and cotton bandage, I found further reinforcement necessary for filling in the transverse metatarsal contours and buttressing the margin of the cupped heel Such a material was also essential for the wedging of the heel to establish an equal plane with the anterior weight-bearing surface I found that bottom filler for shoes, consisting of ground cork and cement compound, was just what was required A compound such as this is made by Pochins In fact, I used this in the first place before cement I later experimented by adding the cement to the cork compound to the extent of one-half the volume of the bottom filler used As a final cover for the under surface of the insole I found a light basil split, coloured dark brown, to be very suitable, as it gave a clean finish and was a very serviceable colour for the part coming into contact with the shoe I tried various methods of finishing the upper surface of the appliance, as at times the leather was slightly stained, preventing a perfectly clean finish I found that where the leather came out clean in the completed appliance a natural finish was very suitable for an insole, which,

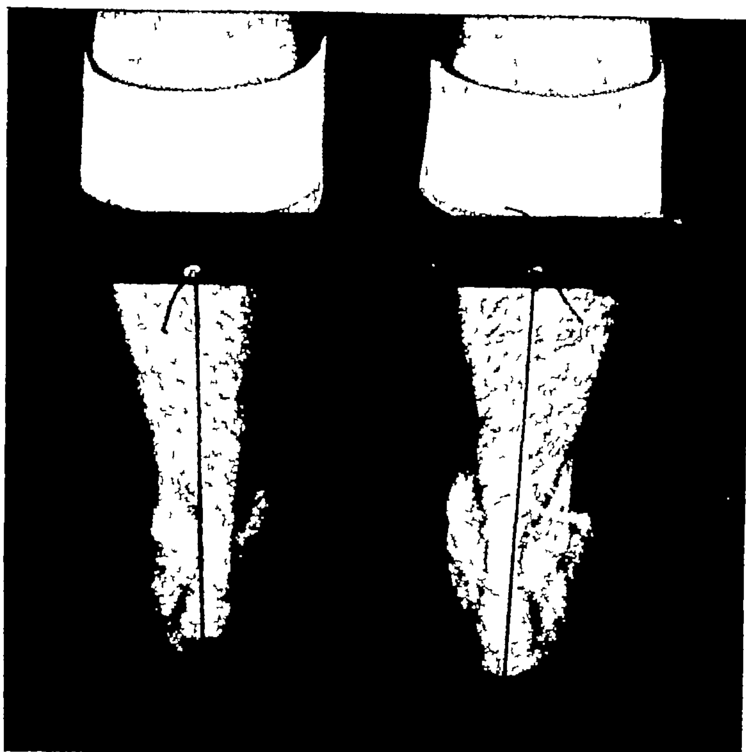


FIG 52

Plumb-line device showing the swerve of the Achilles tendon in pronated feet

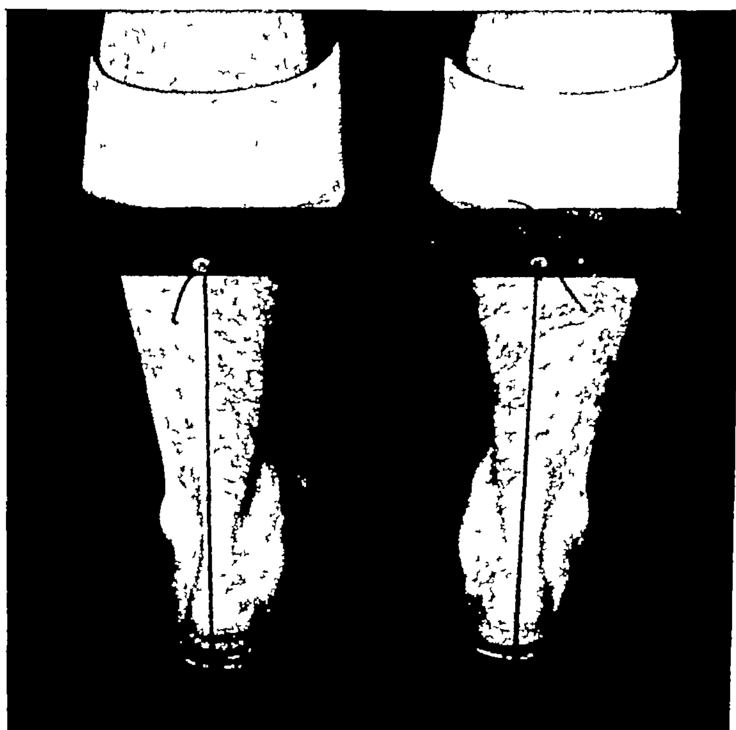


FIG 53

This plumb-line device clearly shows the corrective effect of the appliances independent of footwear

laced on firmly with the twine by passing round the dorsal surface of the cast and through the perforations Care must be taken to smooth out all folds and creases, particular care being taken round the heel It will be found that a good method of lacing round the heel portion of the leather is to use one of the transverse lacings as an anchorage and lace the heel leather from this in a fanwise fashion (Fig 54) Care should be taken

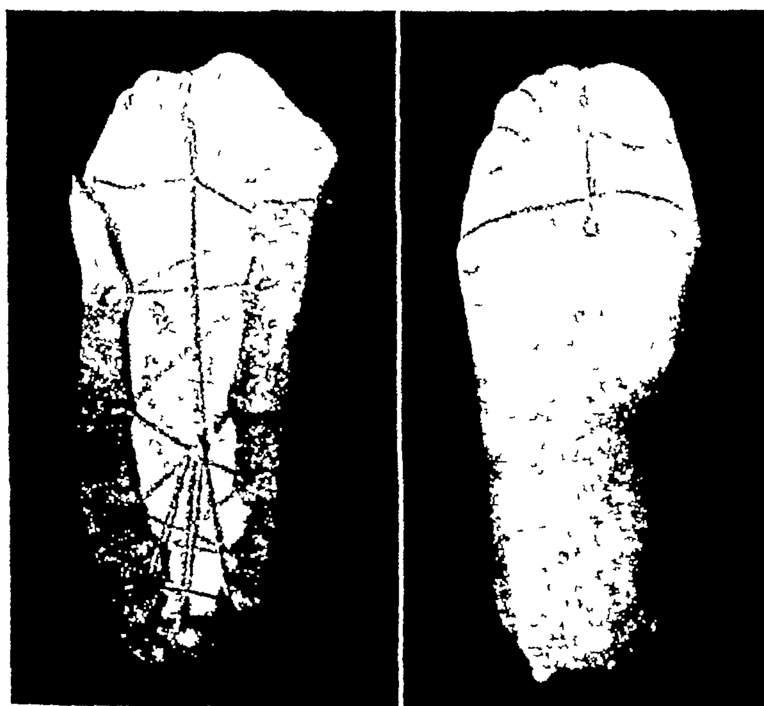


FIG 54
The method of lacing the basic leather in position

to see that the leather is smooth and free from pleats round the margin of the heel and lateral flange Whilst lacing on, the leather should be pressed out with the ball of the thumb and, if this is done, no great difficulty will be experienced

When the leather has been fixed firmly in position it should be dried slowly by holding it a little distance from a gas or electric radiator, although it will be found that most of the moisture will have evaporated by this time

after all, was not a cosmetic article but a surgical appliance made to prescription. Another finish was a buffed surface obtained by scouring with No 1 glass paper A very satisfactory result was obtained by cutting a piece of natural finish basil split, latexing the surface of the appliance and the under surface of the basil, carefully covering the appliance with the basil and moulding it over the edges I then covered the under surface with dark brown leather, fixing it in place and trimming it flush with the edge of the support to give a neatly trimmed edge The simplest method was to apply leather paint to the upper surface and cover the underside with a dark leather This gives a good serviceable finish which is less difficult and saves much time

Processing

Having described the various materials and methods of finishing the appliances, we come to the actual manufacture The technique used by the writer at present has been arrived at following many months of experiment, and is claimed to be simple and entirely satisfactory The word "simple" implies that no complicated process is involved It must be realised, however, that practice is necessary before the required standard of skill is reached It is therefore strongly advised, if at all possible, to carry out practical training under the supervision of an experienced instructor

The first step in making the corrective insole is to cut out a piece of the soft sheepskin to a size and shape which will cover adequately the plantar surface of the cast and extend well up the sides and around the heel The leather is now roughly shaped to the flanges and the heel with a sufficient margin of spare material When this has been done, perforations are made round the edge at about 2-in intervals with a leather punch The next stage in the process is to wet the leather Do not soak, but moisten sufficiently well to assist in stretching over the contours The material is now placed over the plantar surface of the cast, and a piece of twine attached through one of the perforations to the anterior inner corner The leather is now stretched tightly over the cast and

to use this material to fill in the hollow behind the metatarsals, strengthen the medial arch and square up the margin of the heel It has been found that in wear corrective insoles are submitted to considerable stress at a point situated at the mid-shaft of the first metatarsal This is due to the corrective

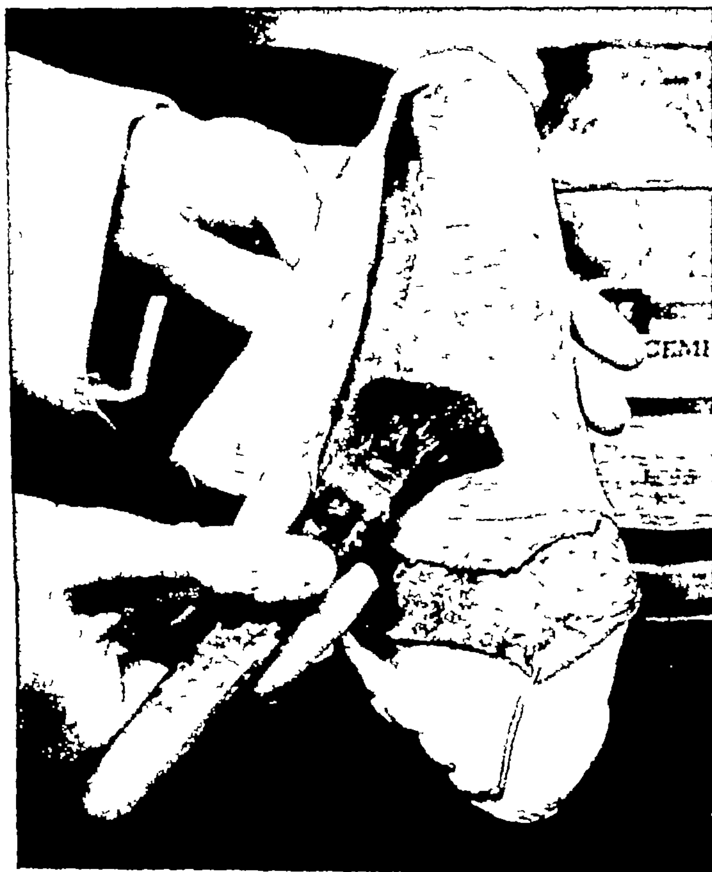


FIG 55
Applying the laminations

effect coming into play, namely, the twist on the forward platform of the appliance which induces a desired depression of the head of the first metatarsal The severe thrust at this point resulted in a fracturing of a considerable number of the appliances and led to reconsideration of the laminating technique as applied to corrective insoles This problem was eventually successfully overcome by applying a strip of sail-

Reinforcing Laminations

The next stage is application of laminations of a suitable cotton material as a means of reinforcement This is done by a liberal application of the cement, a generous coating being applied to the leather, after each strip of the material has been applied There is still room for considerable experimentation in the field of laminations, and the author is still carrying out investigations with the object of evolving the most effective technique

One method which has proved very satisfactory is to apply a strip of material down the centre from the anterior margin of the leather to the back of the heel, the strip being pressed on to the cement and brushed firmly into position, with a further application of cement After the central strip is in position a strip is carried round the sides of the appliance from the first metatarsal to the fifth (Fig 55) This is secured in a similar fashion, surplus material being folded on to the plantar surface Central and marginal strips may be placed alternately until the desired strength is achieved A total of three marginal and five plantar strips have been found to give the required strength

It is thought that a further improvement in lamination has been achieved by placing part of the lamination on prior to the corking, and the remainder after the corking has been applied and finally shaped

A still further method which appears to increase considerably the strength of the appliance is to apply the laminations in alternating longitudinal and transverse strips In applying the transverse strips the author has used lengths of fabric 2 in wide, these being fitted so as to overlap each previous strip by half its width The number of layers can be varied accord ing to the requirements of the appliance, quite a substantial insole can be made with 3 longitudinal and 2 transverse laminations

Where a strong corrective insole is desired for an over-weight patient a further two layers can be added to advantage With the increase of laminations a correspondingly less quantity of cork compound will be required It will be only necessary

the first metatarsal and beneath the internal cuneiform and navicular to the sustentaculum tali, graduating off to a thin skin beneath the fifth metatarsal and round the lateral margin Another point of reinforcement which is particularly important is the lateral flange, as this is to form a buttress to withstand



FIG 56

Spreading on of the cork compound

the thrust of the calcaneum The compound should be applied to a depth of $\frac{1}{16}$ in at the base of this flange, thinning away towards the anterior portion and upper margins Since the outer buttress extends as a graduated flange forward on the lateral margin of the appliance, a reasonable coating should be carried along this portion The heel should now have our

cloth over the area covered by the first and second metatarsals This material should be thoroughly saturated with the cellulose cement and applied firmly It should be noted that every layer of laminating strips should be firmly pressed down as they are applied. It is a good plan to further press down the laminations about one hour after completion, smoothing them down firmly with the thumbs The time factor, however, is variable, governed by the effect of the atmospheric conditions on the speed of drying out, therefore the practitioner will have to experiment in his own laboratory to ascertain the exact time when the final pressing should be carried out.

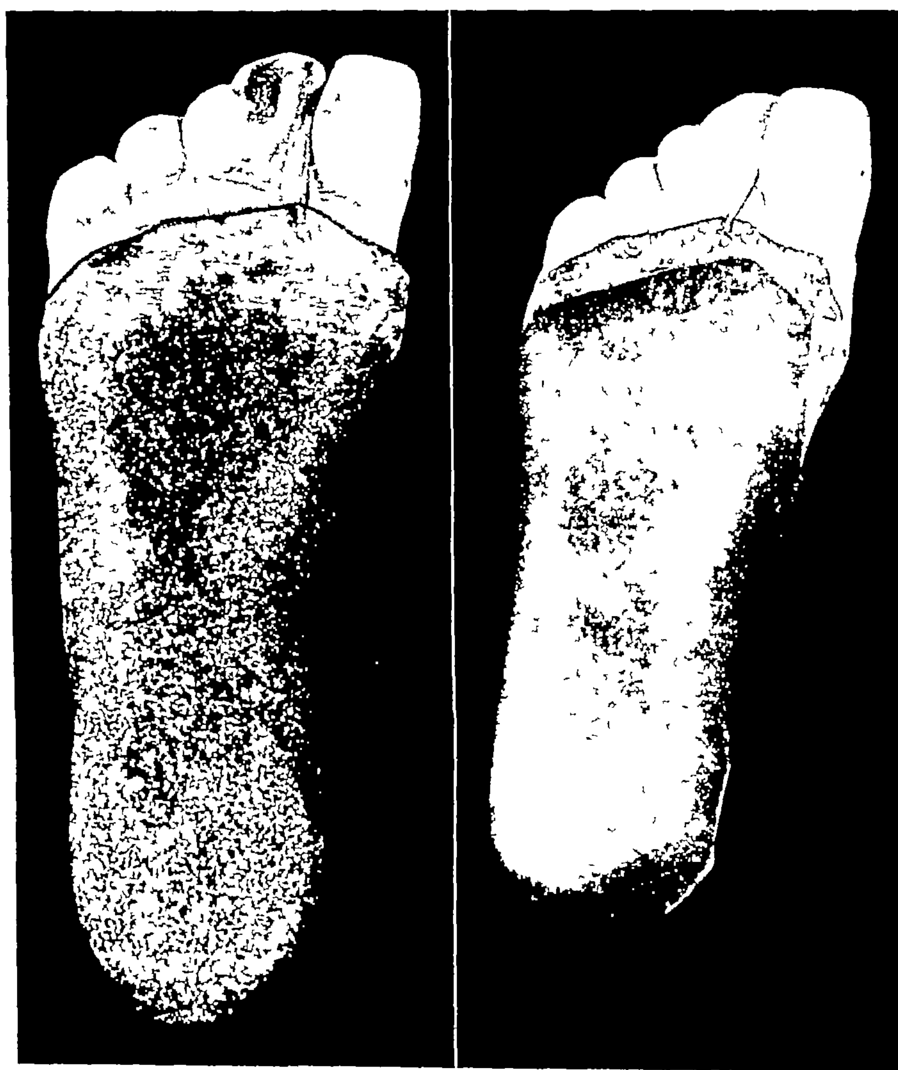
It may be considered a good guide to the appropriate time if the appliances are allowed to stand until the upper laminations are dry On pressure the thumbs will be found to sink slightly into the laminations, and if they are pressed firmly forward from heel to ball, the laminations will be pressed into a further and closely knit unit

It is interesting to note that, when discussing the fracture problem with an orthopædic surgeon, the author was informed that this pressure point, at the mid-shaft of the first metatarsal, had been noted when reforming the arches in plaster of paris in the treatment of traumatic flat foot The pressure and friction on the plaster casing at this point frequently resulted in a plaster ulcer

Cork Compound

The cork compound is known in the shoe trade as bottom filler It is used for filling in the space between the welt and inner sole to level up the bottom surface before the sole is applied It will be found most suitable for our purpose if mixed with cement A suitable quantity of the compound can be mixed on a piece of board, using a metal spatula or table knife When ready, the mixture is spread on the plantar surface of the appliance, filling in the metatarsal contours along the central plantar surface and up the medial flange (Fig 56) It should be spread so that it thins away at the margins and is at its maximum thickness at the points where the greatest reinforcement is required, i e along the shaft of

and the edges polished hard and smooth This is done by applying a little of the diluted cement gently with the finger tip and rubbing it off lightly The leather, if soiled, may be



a *b*

FIG 57

a Insole with the cork compound applied *b* Outer leather secured in position

treated with an application of leather paint which will give it a clean substantial finish The whole appliance may be polished off with a little white shoe cream When completed, the appliance will be found to be firm and strong, yet flexible

attention, and a little of the compound should be applied to the margin to square it up and strengthen the cupped heel effect. On the plantar surface of the heel, care should be taken to build up the medial side until the surface shows a horizontal plane with the anterior weight-bearing surfaces as previously described Should the compound tend to drag out or get rather "gluey," a little more of the cement applied with the spatula or knife will enable it to be trowelled out smoothly into the required shape When this stage of the process is finished, the appliance should be placed in a warm dry place and allowed to set hard It is advisable to leave the appliance for at least 36 hours before proceeding to a further stage in the process (Fig 57*a*)

When the compound is set firmly, the outline of the finished appliance should be marked out on it ready for the smoothing down process This is done by sandpapering down the flat surfaces until they are smooth, also the compound should be thinned down at the margins outlined upon it so that the edges of the appliances will not be too thick In fact, the principle is to remove all superfluous material so that the finished appliance is as light and thin as possible, retaining the necessary strength When the scouring down is completed, the thin covering for the outer surface of the appliance is cut to shape A coating of cement is applied to the insole The thin leather is stretched upon it and pressed down firmly (Fig 57*b*) At this stage careful smoothing out will obviate any tendency to wrinkles This requires care, particularly round the heel It should be held firmly in the hand for a few minutes, pressing the edges down until the cement has set If a thin solution of cement and solvent is used, it will flow easily and set more quickly When the leather cover is set, the string lacings are cut and the roughly completed appliance can be removed from the cast (Fig 58) It may now be trimmed down to the required shape It will be noted that frequently the leather next to the cast is damp It will quickly dry, however, when exposed to the air When the insole is trimmed to its final shape the edge can be smoothed off with a piece of fine glass paper The leather, if clean, may be left as a natural finish

and light in weight Important points to note are that a liberal quantity of cement should be mixed with the cork compound (bottom filler), it is not sufficiently firm and strong without this It is also important to remember that the appliance should not be released from the cast until it has thoroughly



FIG 58
The string lacing is cut and the appliance removed from the cast

dried out, five days to a week is advisable, otherwise distortion will occur

The securing of the bottom leather whilst the appliance is still laced to the cast enables the cement to be used for this purpose, thus still further strengthening the appliance One disadvantage, however, is that great care must be taken in scouring the cork compound before the leather is applied, as further scouring, except in the shaping of the edges, will spoil

its appearance It is not always easy to determine the amount of cork compound to be scoured away whilst the appliance is still on the cast In this processing technique care must be taken when applying the compound, ensuring the correct thickness at each point so that very little scouring is necessary. Recent experiments by the author have resulted in an alternative technique, enabling the appliance to be finished after removal from the cast

The Alternative Technique

In this method of processing, the procedure is the same as in the method previously described up to the stage of applying the cork compound When the compound has been applied, the appliance is set at one side for about 5 to 7 days to dry out thoroughly, no bottom leather is applied at this stage When thoroughly dry, the appliance is removed from the cast, enabling it to be shaped and scoured without difficulty The advantage of having the appliance free from the cast when scouring is obvious Not only can it be handled more easily, but the amount of scouring required at any point of stress is more readily perceived (Fig 59) When the appliance has been shaped and scoured, it can be covered in a soft basil split leather The appliance is first treated with a good quality rubber solution The top leather, after being similarly treated, is secured in position, care being taken not to press out the flanges The top leather is taken over the edges of the appliance and secured on the underside (Fig 60). It will be found adequate to take it over about ¼ in The next stage is to scour or skive down the overlap so that it does not leave a ridge, after which the underside is treated with solution and the bottom leather secured in position When finally trimming the edges of the bottom leather, cut it slightly under the margin of the appliance (Fig 61) The reason for substituting rubber solution for the gum is that the gum tends to soften up the appliance again, resulting in distortion when drying out A useful feature of this technique is that a trial fitting of the appliance is possible before the final covering leathers are fitted This enables any modification to the appliance to be

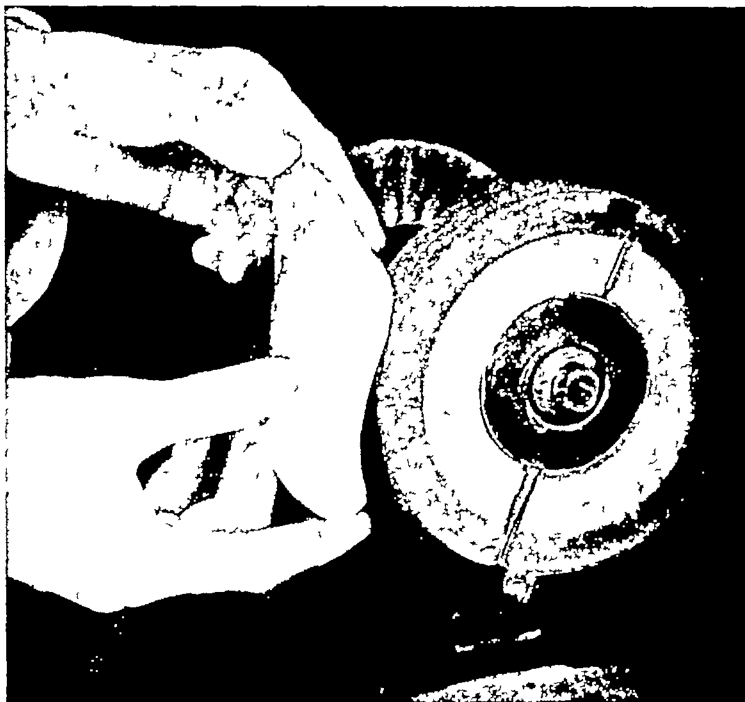


FIG 59

Shaping the appliance on the scouring wheel
(Alternative technique)



FIG 60

The top leather being secured in position

carried out with the minimum of trouble and without spoiling its appearance

In cases of pronation resulting from a short first metatarsal, stability can be restored by making a corrective surgical insole with a degree of elevation built beneath the metatarsal head The elevation should be of sufficient thickness to make the first metatarsal weight-bearing without the necessity for the foot to tilt inwards, and should take the form of a hinged extension In taking the impression for the cast, the heel



FIG 61

Trimming the bottom leather

should be inverted as in the case of the foot with normal bony architecture Care should be taken to prevent any degree of pronation by maintaining a very firm resistant pull on the leg with the hand round the ankle and exerting a lateral traction of sufficient strength Any pressure on the head of the first metatarsal should only have the object of aligning it in correct relationship to the lesser metatarsals This means that in the cast the head of the first metatarsal will not stand stable on a flat surface and in consequence the cast will topple inwards The next step is to pack beneath the head of the first metatarsal on the cast until the foot is stabilised Note the thickness of the packing, as in this way the correct degree of elevation on

the finished appliance can be determined The appliance, of course, cannot permanently correct a pronated foot of this type as the basic structural fault will always remain, but with appropriate treatment for the development of healthy muscle tonus and with the establishment of ligamentous control the appliance can be reduced to the very light type, its principal function being to provide the necessary elevation upon which the head of the first metatarsal can establish weight-bearing contact and maintain postural stability The surgical insole outlined is designed to exert the maximum corrective effect The lateral buttress may be continued as a flange, it should be relatively low after about the first one and one-half inches which is the buttress proper The flange becomes very shallow at the anterior portion The effect of the flange is to keep the forefoot fully under control and correctly positioned on the anterior platform of the appliance It is realised that an appliance of this type in the case of women necessitates a flat-heeled, broad-waisted shoe to accommodate it This is not because the appliance creates any problem on the score of bulk, but because of the width of the anterior portion It has been found possible to sweep in the medial portion of the appliance and reduce the flange anterior to the navicular to a considerable degree This modification greatly assists in fitting the appliance in ladies' shoes

For an adult a broad-waisted walking shoe with a heel not exceeding 1¼ in is most suitable, but in the case of adolescents and young children the "nature-form last" children's shoe is ideally suited The principle of treating children by the user of appliances has in the past not been regarded with favour Whilst many of the milder cases of long arch weakness in children correct themselves without treatment, many cases of severe pronation not only fail to correct in this way but by neglect result in other complications—round shoulders, pigeon chest, defective gait, etc This new form of plastic appliance is extremely light, and has the right degree of resilience It does not interfere with normal foot function, but by holding the foot in correct position assists in re-education in walking, and where employed together with remedial

exercises should establish stable and healthy feet By re-establishing stability a normal gait is assured.

In the course of experiment and development of these appliances they have been employed effectively in young children of $2\frac{1}{2}$ years of age and even younger Orthopædic surgeons who are now familiar with these appliances are unhesitatingly prescribing them for children

Adults under treatment with this system of correction may, if desired, be fitted with a specially modified pair for wear on social occasions when more fashionable shoes are indispensable It is strongly urged that such modified insoles should always be worn when the fully flanged appliance is not in use. This should, however, be resorted to as infrequently as possible, the fully flanged insoles being worn continuously for all general purposes

The Modified Type of Insole

The insole can be modified to fit the more fashionable narrow-waisted shoe by reducing the inner flange in height and length The flange, however, should extend to just beyond the navicular From this point the medial side of the insole can be shaped to a curve toward the lateral side, the anterior platform of the appliance being just wide enough to provide support beneath the first metatarsal The lateral flange can be dispensed with, leaving only the outer buttress This, however, should be as strong and firm as in the normal insole. It will not be necessary to reduce the general strength of the insole, and care should be taken not to weaken the anterior platform or medial flange On no account should the appliance be modified when treating mobile pronated foot in adolescents or children

Summary —A final note on the making of the appliances It is as well to consider the use of a power-driven scouring wheel for the trimming and shaping of the appliances The writer uses a $\frac{1}{4}$-h p. motor to drive a small shaft fitted with sandpaper wheel and carborundum wheel

The cement may be applied with a one-inch soft bristle brush The brush will set quite hard in a very short time

after use, but if placed in a jar with enough solvent to cover the bristles it will soften out in a comparatively short time

The use of 18s stout linen thread on a strong needle may be suggested as a substitute for the perforations and twine, but the writer has found that it is an advantage to be able to adjust the lacing in the process of fitting the leather to the cast Consequently, the twine through the perforations is most convenient and on the whole the best method

The appliance should be allowed to dry out as long as possible before removing from the cast for finishing, and on no account should the chiropodist be tempted to rush the work, as quick drying or finishing before being properly set will lead to distortion The finished appliance, when quite firmly set, should be fitted to the patient as soon as convenient, as it is not advisable to have them lying about for long periods since it is possible that a further shrinkage of the cotton reinforcement will exaggerate the curve of the long arch. This tendency is a good thing, however, when the insole is in wear, as it strengthens the resistance to flattening under weight-bearing

The practitioner should take into account the weight of the patient and the severity of the pronation when deciding upon the strength of the reinforcement required This does not apply to the cotton bandage but to the cork compound It is particularly important in relation to the anterior portion of the medial flange and the base of the lateral buttress These appliances have been fitted to obese patients, weighing in the region of 17 stones, with complete success when care has been taken in the design and making of the appliance Adequate reinforcement can be applied without unduly increasing either bulk or weight

CHAPTER VIII

PALLIATIVE SURGICAL INSOLES AND SUPPORTS

THE term "palliative" is hardly a satisfactory description for many of the appliances with which it is proposed to deal under this heading In many instances a combination of protection, support and stabilisation of the foot has not only afforded relief in chronic cases, but, by the very qualities referred to, the appliance has achieved a measure of correction in addition to affording permanent comfort This has been particularly noticeable in long-standing cases of metatarsalgia where restricted mobility of the metatarso-phalangeal joints was specially in evidence In such cases callosities which tend to become vascular are a painful complication A time arrives when repeated reduction of the callosity and the application of adhesives gives little or no relief It is here that the plastic surgical insole incorporating resilient sponge in its anterior portion has proved successful The principle underlying this type of appliance is to relieve pressure on the painful area by diffusing weight-bearing over the whole plantar area Padding behind the depressed painful area has frequently been disappointing because the padding itself has had to exert a conscious degree of pressure in an endeavour to relieve the pain The moulded insole provides a firm controlling embrace to the sole of the foot The perfect accuracy of fit ensures that there is no conscious pressure at any one point The writer carried out experiments with sponge rubber incorporating this material in the anterior portion of the appliance, but in such a way as not to interfere with the principle of diffusion of pressure and stabilisation Before applying the soft leather to the cast in such cases, the area behind the metatarsal heads was hollowed out, particularly behind the painful area Care was taken to graduate the depression in the cast so as to avoid any suggestion of a ridge

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be placed in position and a pencil mark made round it. It is removed and the leather within the pencilled area coated with milk latex or rubber solution The rubber pad is coated also (Fig 62) When the latex or solution is dry, the padding is carefully pressed into position, after which it may be finally shaped on the scouring wheel (Fig 63). The plastic appliance is now built up in the normal way It is a good plan to cover the whole with thin leather secured with latex or solution In this way a plain leather upper surface is presented to which the cement cotton material and cork compound will adhere firmly

Appliances made in this way can be firm and strong, whilst at the same time providing soft moulded cushions for the relief of painful unyielding prominences In certain cases of severe metatarsal defects where the patient desires to wear smart shoes, the appliance can be modified successfully to consist of a cupped heel seat, a slender forward platform in which is incorporated the moulded surgical sponge I recall a case of mild talipes varus which was complicated by a large and very painful neuro-vascular calloused area over the lateral plantar surface of the cuboid In this case a cradle insole incorporating the surgical sponge, further assisted by a laterally buttressed heel, gave complete relief to a patient who had suffered for years

The well-buttressed lateral flange fitting snugly to the contour of the foot provided a firm but comfortable resistance to the lateral thrust of the foot The cupped heel and the snug fit of this cradle support with the soft resilient cushion over the painful area provided stability and relief from painful pressure In this case the buttressed heel was a great help in assisting in providing a firm base against the lateral thrust

Many elderly people find much benefit from rest appliances which are made upon a cast of the feet taken at rest The appliances should have well-cupped heels and low flanges When the foot is weight-bearing, an appliance of this nature will closely embrace it If care is taken to ensure a firm and secure fit in the shoe, there will not only be a support in which the weight is adequately diffused but the foot will be stabilised in such a way as to prevent unnecessary strain on the deterior-

The surgical sponge rubber was shaped to fit correctly into this hollow, so that in the finished appliance the supporting platform round the painful area was yielding and resilient, yet exerting a definite supporting influence under compression The principle of this appliance is that on weight-bearing it provides a resilient support which, as it becomes compressed, offers a uniform supporting cradle This removes the conscious thrust of the ordinary metatarsal pad, yet the embrace of the metatarsal support allows for the proper functioning of the intrinsic muscles In many instances, chronic cases have responded most favourably to such an appliance The mobility of the metatarso-phalangeal joints is restored, and the painful vascular callosities are reduced to a simple thickening of the skin, requiring only occasional attention It has been found advisable to make the appliance for chronic metatarsal defects with a cupped heel and a shallow flange extending on the lateral and medial borders of the foot This controls the alignment of the foot in relation to it, and also on weight-bearing, the sides of the insole close in on the foot, exerting a firm stabilising embrace This appliance is a combination of latex and plastic technique This combination offers many possibilities in the making of rest supports for chronic cases where the foot has been permanently deformed as the result of trauma and when arthritic changes have resulted in painful pressure points, with complete absence or restriction of mobility Diffusion of pressure, support and stability are provided by a rest appliance designed on these lines

Plastic and Latex Technique

In combining the firm yet resilient plastic insole with surgical sponge, the object is to provide a firm stabilising appliance whilst at the same time offering a soft and kindly contact with painful areas The leather is stretched over the cast as in the corrective insole, great care being taken to see that it is fitted faithfully to every depression and prominence The surgical sponge is now shaped to fit into the depression it is desired to fill, the rubber being so shaped as to embrace closely the prominences When the rubber has been prepared it should

ating joint structures Surgical insoles made to this principle often give great comfort and enable the patients to enjoy a more active life

These appliances are truly palliative, but not only do they give relief and help the patient to become more active, but as



FIG 64

Examples of surgical insoles Top left—Corrective insole, Top right—Metatarsal rest appliance, and, below, a cushioned surface rest insole for arthritic flat foot

a consequence can frequently be the means of a marked improvement in both the mental and physical health of the patient Finally, a point not to be overlooked, they have an arresting effect on the deterioration of the bony structure and soft tissues of the foot (Fig 64)

Conclusions—Since the individual characteristics of the human foot are so variable, any treatment making this factor a primary consideration is building upon a sure foundation.

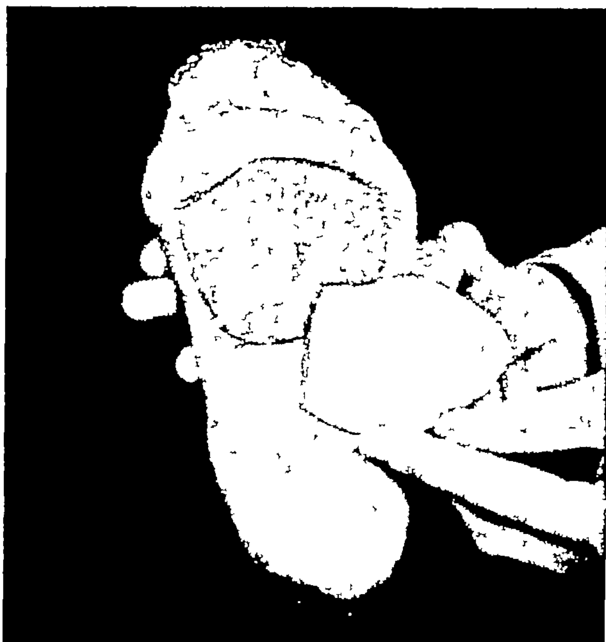


FIG 62

Area marked out and solution applied, the metatarsal pad about to be secured in position

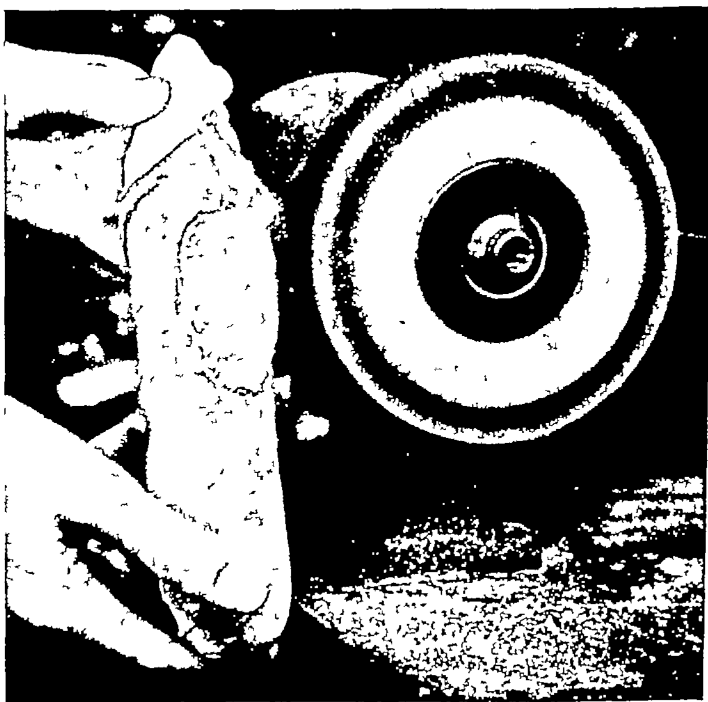


FIG 63

Shaping a metatarsal pad on an emery wheel

appliances are made on individual casts There have been occasions when the author has found this type of appliance appropriate to the case and, as a result, efforts have been made to evolve a technique that will produce a really satisfactory appliance on these lines The results of the writer's investigations and experiment are herewith set down for the consideration of the reader

For this type of appliance a plantar cast admirably meets the case A soft, resilient leather is first carefully stretched over the cast Chamois leather is very appropriate for this purpose It should be stretched tightly over the cast and should be drawn and stretched at every point so that each prominence and depression is accurately embraced As an alternative to this leather the chiropodist may use a fine soft basil split. In stretching this leather great care will have to be taken, as it tears quite easily if roughly handled It will be found advantageous to damp the leather on the underside, as after dampening it stretches more easily The leather should, however, be only lightly damped and not made thoroughly wet, and when stretched over the cast it can be laced on with needle and thread as in the case of other appliances, or affixed with latex strips The next stage in processing the appliance is to brush on a thin coat of latex This should be only lightly brushed on and not allowed to soak through the leather This is achieved by using a soft brush and very little latex at a time, the brush being lightly whisked over the leather This process is carried out until a thin film of latex covers the whole surface This may be set aside to dry or held in front of a stove or electric fire It will be found to dry out very quickly Once this thin film covering the leather has completely dried, further heavy coats may be applied without fear of it soaking through

The next stage in processing the appliance is to fit surgical sponge to the area where special support is to be provided, that is, valgus pad under the instep, padding round painful pressure areas in the metatarsal region When this padding has been shaped and fixed into position, it may be carefully trimmed with scissors or scoured with an emery wheel as in

The author claims that this basic factor underlies the whole principle of this technique

By the method of putty casting devised by the author, a faithful reproduction of the plantar aspect of the corrected foot can be achieved The materials used in this manufacture ensure an exact relationship between insole and foot In this way a reforming and stabilising foundation can be perfected, providing rest and eventual readjustment of affected ligaments Progressive remedial exercises, Faradism and other form of physiotherapy are a necessary adjunct to the treatment, improving muscle tonus and assisting in re-establishing structural and postural stability and normal function

In the rest appliances, the establishment of a firm stabilising foundation and resilient support, with complete diffusion of weight-bearing eliminating pressure points, are vital factors in this form of treatment This is achieved by the combination of the plastic and latex techniques Again, the basic principle of the appliance is that the individual characteristics of the foot are interpreted faithfully

The technique of processing these appliances is simple and inexpensive, requiring little in the way of apparatus, and the materials are readily available

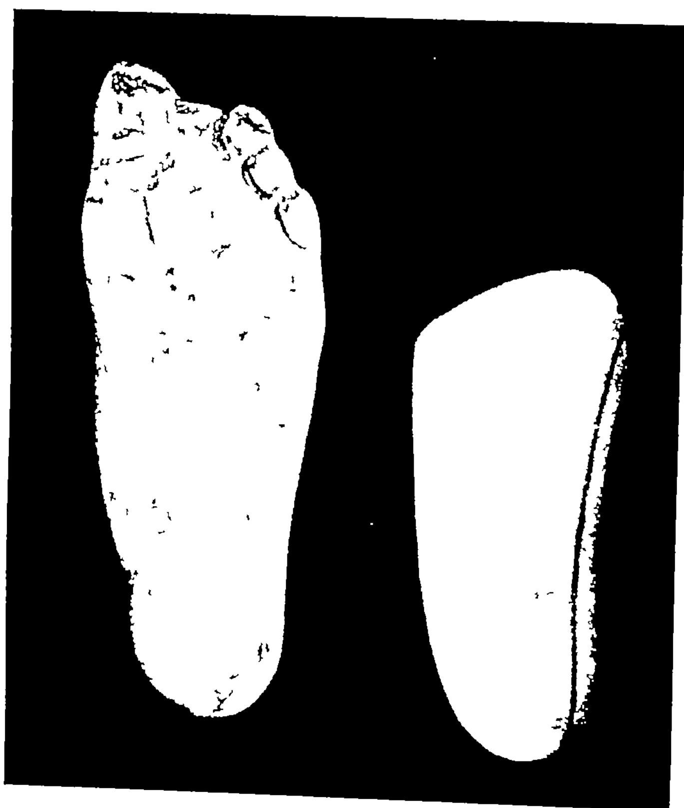
Whilst the results so far achieved are distinctly encouraging, it is too early to be dogmatic about the final results, which cannot be assessed soundly until long and exhaustive tests have been carried out The results from the palliative rest appliances are already establishing the efficacy of this branch of the technique The author has spared no pains in testing both the corrective and palliative insoles to a stage warranting their presentation to the profession

Surgical Sponge Insoles

There are occasions when soft resilient surgical insoles are desired to give a degree of resilient cushioning to the long arch and to the anterior metatarsal area It is realised that appliances of this nature have been manufactured for many years, but as in the case of other types of surgical insoles complete accuracy in fitting is not possible unless these



a



b

FIG 65

a Surgical sponge secured in position and scoured to the final shape by an emery wheel *b* The completed sponge insole with cast

other types of appliances Another coat of latex is now applied and dried in the manner previously described. A sheet of thin surgical sponge is shaped to cover the whole plantar area of the cast The side which is to contact the cast is lightly scoured to ensure the latex obtaining a firm hold, after which this side is given a coat of latex milk rubber When the two surfaces have dried, this thin sheet of rubber is fixed in position, after which the margin is carefully skived to avoid a thick edge Again, this may be done with a high-speed emery wheel, if available (Fig 65*a*) The exposed surface is lightly scoured and coated with latex, which is again dried A piece of fine soft basil split is trimmed to shape, latexed on the underside and, when dry, laid in position and smoothed down over the plantar surface of the appliance (Fig 65*b*)

When completed, the appliance may be removed from the cast and the surplus trimmed off The result will be a soft and resilient appliance which will fit accurately to the foot, giving a soft, cushioning support The appliance is principally palliative in effect, but as in all such appliances once relief and comfort have been established the patient will use the feet with greater confidence and tend to resume a more normal gait This is bound to have its effect upon circulation, muscle tonus and the re-establishment of muscular balance, making for improved function

This type of appliance is often improved by making it in the form of a full sock To do this the leather stretched on the cast should be allowed to extend well beyond the toes, although it should. only be secured to the same extent as the half-sock appliance If the lining sock of the patient's shoe can be removed it may be used to ascertain the total length of the appliance and as a guide for shaping the sole part In processing the appliance the medial arch should be fitted with the rubber valgus pad, after which a full sock of thin surgical sponge should be secured from heel to ball, leaving the sole portion extending forward insecured Any final scouring and shaping of the half-sock portion of the appliance should be completed, after which the final leather bottom cover is secured in place again only up to the half-sock To complete the

their effectiveness, and the chiropodist must apply himself with painstaking diligence to designing the shape, thickness and position of these pads

Valgus Pad—Where the treatment of pronated foot is contemplated, a combination of valgus pad and medial heel wedge is desirable A drawing of the outline of the foot should be taken with the patient seated. The drawing should be marked to indicate the position and length of the long arch The length of the foot from the back of the heel to the head of the first metatarsal should be measured with calipers.

The sponge rubber should be of moderately firm consistency Latex foam will be found too soft for this purpose The pad is built up of two parts—the longest piece provides the foundation of the valgus pad and the medial heel wedge, this valgus support being accentuated by a further D-shaped pad which is superimposed on the first piece of rubber The completed pad is now bevelled from its anterior border round its lateral side The bevel is carried round the whole curve of the valgus pad, blending with the heel wedge. The insole of the shoe is now cleaned with petroleum, ether, or some other suitable spirit-cleaner to remove dust and grease, after which it is roughened with sandpaper

The insert is now secured in position with rubber solution, and the operation is completed by covering with an insole of thin soft basil leather

This form of insert may be made by first completing the valgus pad and heel wedge separately. About ¾ in should be thinly bevelled The heel wedge is attached by the extra bevelled portion This latter method is probably the more simple way of making this form of insert

Another form of valgus pad incorporates a plantar metatarsal pad Again, it is a more simple method to shape the metatarsal pad and valgus pad separately, and then fit them in the shoe in their proper relationship.

The object of the valgus pad is to lessen the strain on the inverting muscles and to reduce the strain on the supporting ligaments Strain on the plantar fascia is also reduced by this form of valgus pad. The pad may be the conventional

appliance it is now removed from the cast and the insecured portions of top and bottom leathers secured to the rubber sole part, which is finally shaped with scissors

Sponge Rubber Supports

Flexible appliances of this type are frequently referred to as non-rigid supports, but we feel that this term is somewhat misleading It is assumed that metal appliances and others that present a firm unyielding surface to the foot are designated "rigid," but many of these appliances possess a degree of springiness which compensates for the normal sling effect of the leg muscles and can in consequence hardly be classed as rigid It is therefore advisable to refer to appliances made from soft spongy materials by a descriptive title other than that of non-rigid

One type of sponge rubber insole has been described which was moulded on to leather stretched over a cast of the foot This type of appliance, by the very exact nature of its construction, is the most efficient form of support moulded from surgical sponge rubber Whilst, however, the sponge rubber appliances are soft and comfortable to the foot, their effectiveness is dependent on soundly constructed shoes that are well balanced and have strong rigid shanks

A much simpler type, however, can be made, which if carefully designed and constructed will prove very beneficial in many cases where mechanical correction or support has to be of a limited character The sponge appliance can be made in a variety of ways They may take the form of simple inserts solutioned to the insole of the shoe and covered with soft basil leather or kid, or may be constructed in the form of a full-length surgical sock or half-sock, with the pads secured in the appropriate places

Inserts

Sponge rubber inserts may take the form of metatarsal pads, valgus pads, a combination of both, or heel pads It will be realised that pads of this type depend upon accurate fitting for

constructing a pad of this type is to shape and fit the deflecting pad and superimpose the broader insulating cover over it Care must be taken when fitting to press down and secure the cover anterior to the deflecting pad so that the necessary hollow is provided The insulating cover should extend to the base of the toes.

Whilst single and double wing pads are frequently quite effective in this type of insert, a more complicated pad requiring a very precise positioning is not on the whole very satisfactory in this type of fitment They require the foot to be securely anchored in relation to them, and the play in the shoe will usually allow the foot to become displaced in relation to the pad, and result in much discomfort to the patient

Heel Pads —A sponge rubber insert, however, is very satisfactory for the relief of calcaneal spur The writer finds that a more satisfactory method than the conventional aperture in the pad at the site of the spur is to cut a deep hollow in the pad on the underside This is treated with rubber solution as well as the whole under surface of the pad When being fixed it is pressed down firmly in position at the point of what is now an inverted hollow or dome This will make a permanent depression with smoothly rounded sides, but with a thin soft layer of rubber as a final insulation against pressure on the tender area on weight-bearing When this pad has been secured in position a thin soft cover of basil or kid will complete the job A pad of this nature but without the depression will, on occasions, prove adequate in the treatment of achillo-bursitis, by lifting the affected area clear of the back of the shoe

Shaping and Bevelling —If sponge rubber pads are to be comfortable and effective, it is necessary that their shaping and bevelling should be accurately and neatly carried out Trimming with scissors is a method which requires much skill and painstaking application if the pads are to be cleanly shaped and smoothly bevelled It is quite a good plan to fit pads that have been bevelled with scissors, with the flat side uppermost, as when fixed in position the soft flexible material shapes itself in reverse and in this way a clear smooth surface is presented to the foot The writer has found that the most satisfactory

D-shaped wedge, the straight edge being the thickest part of the pad

A modification of the pad is made by cutting a circular piece of sponge rubber bevelled away to the margins, the equivalent to placing two wedges with straight edges together A deep V-shaped cleft is cut down the centre of the upper surface of the circular pad The cleft is treated with rubber solution and its sides brought together, forming the pad into a right angle This form of pad not only supports the navicular but exerts a lateral thrust against it The heel wedge is designed to tilt the heel with the object of bringing the calcaneum from eversion to an upright position

When fitting inserts incorporating a valgus pad it is important to ensure that it extends over the whole area of the dome of the long arch The heel wedge should be sufficiently broad to extend to the middle of the heel seat of the shoe It is not easy to calculate the exact thickness required for the valgus pad, as the curve of the shoe waist has to be taken into account, and some degree of experimentation will no doubt be necessary even when the accommodating qualities of the soft tissues are allowed for

Pes Cavus Insert—A useful and simple form of insert for pes cavus to assist in achieving a uniform distribution of pressure is to fit a pad of sponge rubber in the waist of the shoe The rubber pad should be bevelled away at the anterior and posterior ends, and should be of sufficient thickness to fill in the space between the long arch at its outer border and the floor of the shoe The pad should extend the full length of the arch, and the calipers should be brought into use to ensure that it is properly placed The lining sock should be removed from the shoe before inserting the pad, and should be refitted over the pad

Metatarsal Pads—In designing plantar pads for metatarsal defects, it is advisable not only to pad directly behind the area to be relieved and supported but to provide both anterior and lateral insulation The pad fitted in position to the pressure point deflects pressure, whilst the thin insulating padding cushions the wider area The most satisfactory method of

constructing a pad of this type is to shape and fit the deflecting pad and superimpose the broader insulating cover over it Care must be taken when fitting to press down and secure the cover anterior to the deflecting pad so that the necessary hollow is provided The insulating cover should extend to the base of the toes

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method of shaping sponge rubber pads is by the use of a power-driven emery wheel revolving at a fairly high speed The type of wheel used is one as used on a shoemaker's finishing machine The wheel is in two halves, hinged together It is made of wood and has a layer of compressed felt round it The emery paper is fitted round the wheel by engaging the sides of the strip on metal spikes fitted near the rim of the two halves of the wheel The two parts are closed, which tightens the emery strip upon it A locking device is screwed home and the whole is firmly secured The one used was modified to fit on a small stand fitted with "V" pulleys, and the results have proved most successful Pads shaped by this method have a really well-finished appearance, and make this inexpensive and simple piece of machinery well worth while, especially as it is a valuable piece of equipment for the processing of many other forms of appliances

It is most important to cover all sponge rubber inserts with a soft thin leather If this is not done they will cling to the foot, either preventing it fitting properly into the shoe or the pad will be dislodged in the attempt to insert the foot in the shoe Whilst latex foam rubber is very soft, fine in texture, and most comfortable, it is not suitable for use in inserts, as its extreme softness allows it to be depressed too completely on weight-bearing, and as a consequence the thickness required for adequate cushioning is too great for use in the form of inserts, and this material does not lend itself to shaping by use of the emery wheel

Sock Appliances —Socks, or insoles as they are alternatively called, are the basis of a form of simple appliance which has been in common use for a great number of years The form of padding used in appliances of this type is in the main similar to that used as inserts which have already been described The sock type merely consists of building the padding on to a leather sock which can then be inserted into any shoe This, of course, obviates the fitting of several sets of inserts into the various shoes of the patient

The sock should be sufficiently flexible to press down and mould itself to the contours of the shoe insole, whilst being

sufficiently stiff to avoid curling up at the back of the heel A very satisfactory method of making a surgical sock is to use two pieces of leather, a firm piece—a piece of fleshing will do —and a soft kid or basil top leather The sock should be an exact replica of the insole of the shoe This is necessary if undue play is not to occur in wear, causing a malpositioning of the padding

A simple way of taking a pattern of the shoe insole is to cut out a piece of paper of sufficient length and width to fill the shoe insole with some to spare Place this paper in position, taking care to press it well into place, then get a pair of closed scissors or other suitable instrument and run the point round the margin of the insole, pressing sufficiently firmly to crease and mark the paper, but taking care not to ruck or tear it When this is accomplished the paper should be carefully removed from the shoe and trimmed along the crease, outlining the insole This pattern can be used in cutting out the leathers for the insole If the shoes are new and possess a a leather lining sock, this can sometimes be removed and used as a guide for shaping the sock It should be noted that a generous margin should be allowed when cutting out the top leather, as it has to be folded over the outline and thickness of the padding

When leather and padding are shaped, they are assembled by first securing the padding in position on the bottom leather, after which the top leather is carefully moulded over the padding and secured firmly to both padding and bottom leather If all portions have been secured by a good rubber solution or latex milk rubber, the sock should stand up to reasonably hard wear If desired, a row of stitching can be carried round the edge of the sock to give further strength and finish

Care in positioning the padding is most important, and the calipers will be a most useful instrument in measuring from the back of the shoe heel (inside) to the points of pressure or anterior margin of valgus pad, etc

In some chronic cases it will be found advantageous to fit deflection padding in position and then cover the whole sock

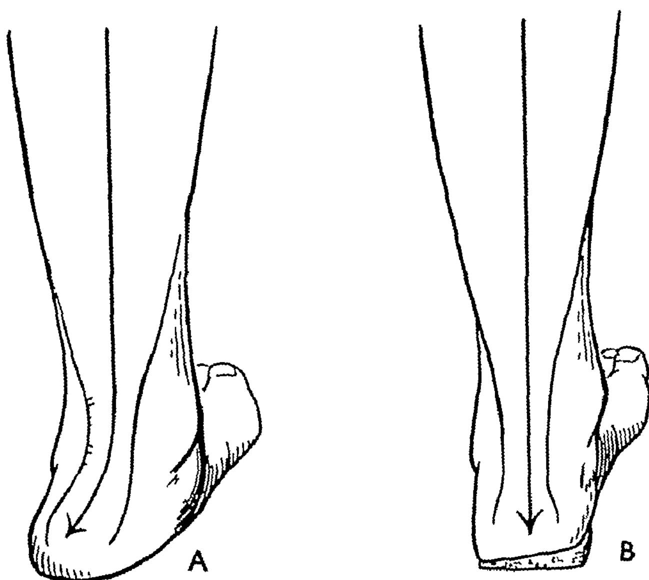


FIG 66

a Showing eversion of heel and inswerve of tendo-Achillis when foot pronated *b* Showing corrective effect of wedge Heel is inverted

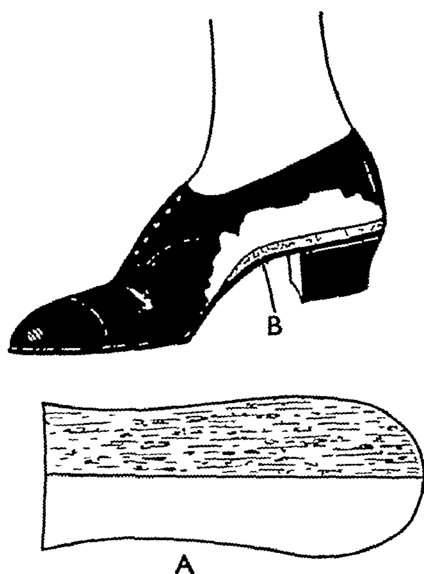


FIG 67

a Underside of cork wedge showing cork extending mid-way across leather heel sock *b* Cork wedge in shoe

with thin surgical sponge, finishing with a covering leather This simple form of appliance is inexpensive and frequently proves quite adequate

As in the case of inserts, the form of padding used is based upon previous experience with the patient with felt or surgical sponge in the normal course of treatment

Cork Wedging —A very simple and inexpensive form of sock appliance that can be used as a replaceable sock or be permanently fixed in the shoe is made by using fleshing for the sock and cork for the wedges Fleshing is loose offal removed from the underside of bend leather, compressed and impregnated with a stiffening substance This form of leather is very cheap, but nevertheless makes a firm, clean material for the sock A sock of this type makes a very useful appliance for contra-lateral wedging (inside heel and outside sole wedge) The cork wedges can be secured to the underside of the sock by a good rubber solution If desired, the finished appliance can be secured in the shoe in the same way The use of cork for these wedges results in a very light appliance and has proved quite satisfactory In the appliance referred to, the sole wedge should extend from the centre of the toe of the shoe and cover the whole half of the sole The wedge should graduate away to a paper edge in the middle of the sole, so that any suggestion of a ridge is avoided This method of wedging, whilst being simple and inexpensive, is not quite as effective as wedges inserted between the middle sole and outer sole The discrepancy is that the internal wedge causes angulation at the midline of the sole and heel The insole method, however, is a useful alternative where difficulties are encountered in getting the work carried out or the problem of expense arises The insole may be fitted with medial cork heel wedge only for mild pronation, and this type of appliance is useful as a lateral heel wedge when required as a buttress in the case of weak ankle Leather wedges may be substituted for cork if desired or if found more practicable for any reason

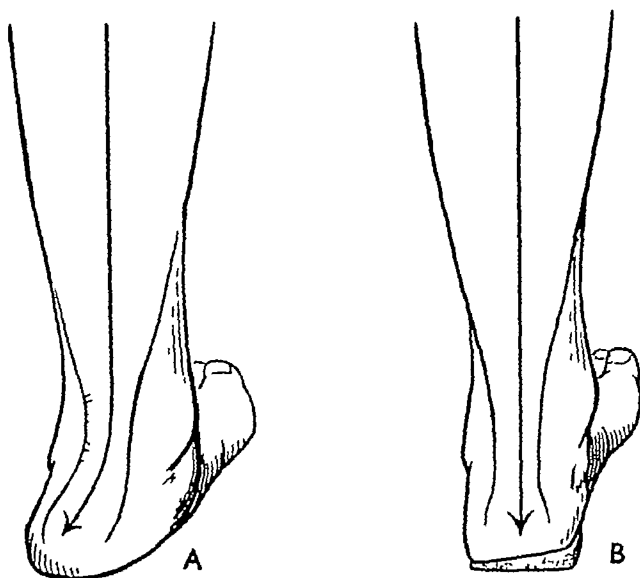


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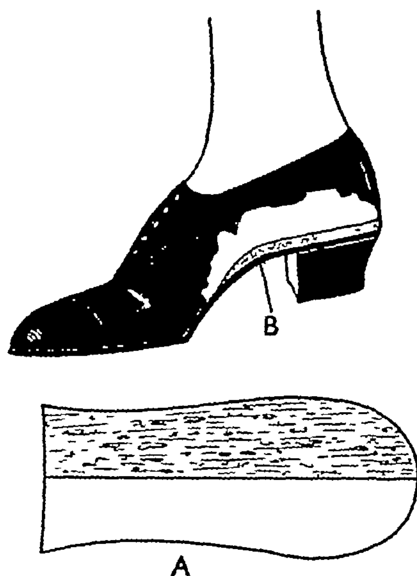


FIG 67

a Underside of cork wedge showing cork extending mid-way across leather heel sock *b* Cork wedge in shoe

taken to avoid forming a ridge down the centre of the heel where the wedge terminates

Blocked leather insoles are also made for pes cavus, the object, as in all rest appliances, being to diffuse pressure

The appliance is often made more effective by making depressions in the insole to receive the painful callosities beneath the metatarsal heads. Insoles of this nature are designed with both an inside and an outside flange, and are usually cemented firmly in the shoe

Whilst this method of processing surgical insoles is perhaps

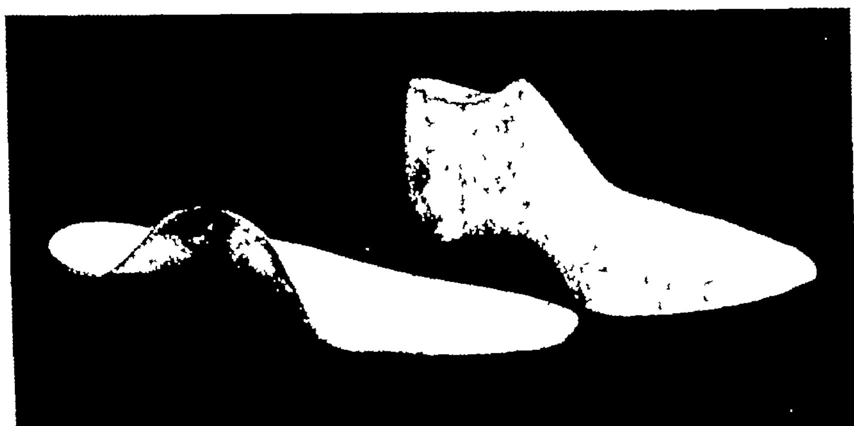


FIG 68

Showing blocked leather insole and the last upon which it was made

the oldest, it is still used by surgical and bespoke bootmakers, and is much more effective than many of the commercial appliances which have not the advantage of being made so near to the shape of the patient's foot

Blocked Leather Insoles with Cement Reinforcements

Blocked leather insoles have recently been made using saddlers' leathers in place of the vegetable-tanned sole leather which is almost impossible to obtain. The leather frequently used is a good cowhide bag leather, and the blocking is carried out in the same manner as previously described, except that the prolonged soaking is not carried out, the leather being

CHAPTER IX

BLOCKED LEATHER SURGICAL INSOLES

THIS is the oldest form of foot support, and was usually made by the bespoke bootmaker for a customer who complained of foot pain, particularly if a marked flattening of the foot occurred on weight-bearing.

The blocked leather insole was also frequently prescribed by doctors for patients exhibiting symptoms of long arch weakness The appliance takes the form of a full-length insole with a flange on the inside The material used is light, vegetable-tanned sole leather which has been soaked in water overnight The leather is laid along the sole of the last from heel to toe and secured by two rivets. The leather is then drawn tightly over the sides of the last with lasting nippers, and secured with tingles (small sharp tacks) The leather is beaten lightly with a hammer and gradually moulded to the last The tingles are released and the leather drawn tightly on to the last from time to time until firmly shaped The beating of the leather compresses the fibres closer together, making its texture more compact, and as a consequence firmer and stiffer

The moulding of the leather is assisted by rubbing with what is called a lick stick This is a piece of hard wood or bone, and is usually used for burnishing When the sock has been shaped on to the last by stretching, beating and rubbing with the stick, it is left on the last to become thoroughly dry When removed from the last the insole is found to be firmly blocked to shape, after which it is finally trimmed and skived round the edge on the underside with a leather knife (Fig 68)

This form of insole can be further improved if a leather wedge is fitted on the medial side of the heel portion The wedge should extend to the middle of the heel seat and should be about $\frac{3}{8}$ in. thick, graduating to nothing. Care should be

flexibility is not detrimental, the most suitable material is duraluminium because it is both strong and light Malleable metal may be used quite effectively, the only difficulty being the added weight.

Reinforcement of this nature may be used either in the old type of blocked leather full or half insole support, or in a similar insole strengthened by the use of cellulose cement In certain cases requiring strong rest appliances the author has embodied a duraluminium supporting strip into the cork and cement compound in the appliances made by this process

Flexible Spring Steel Reinforcement

Spring steel is not a particularly easy commodity to obtain, but an engineer's shop can usually supply it It should be remembered that it is only a reinforcement and not the whole support, and should in consequence be light and well tempered One method of obtaining a supply of suitable material is to purchase an old clock spring or spring from a gramophone motor. Springs varying from ½ in to ¾ in wide made from about 22 gauge metal would be suitable

The method employed by the author to fix this form of reinforcing strip is as follows. cut a length of spring steel about ½ in to ⅝ in wide of sufficient length to bridge the medial arch To ascertain the required length, the strip of steel is bent against the medial arch of the plaster cast. It should be held so that it passes beneath the first metatarsal under the navicular to the anterior aspect of the tuberosity of the calcaneum When the correct length is procured, it is held in the flame of a bunsen burner or blow-lamp until cherry red, the metal being grasped at each end by pliers When sufficiently heated, the metal is placed against the cast in the previous position and bent to the required curve and held in this position until it has cooled off and turned black The metal is again heated until cherry red and then plunged into oil. The spring will now have regained its temper Should it be overtempered and brittle the temper can be adjusted by reheating The heat required this time should be only sufficient to burn off the oil again return it to the oil to cool and

only lightly wetted Appliances made from leathers of this type require some form of reinforcement A satisfactory method of reinforcing these appliances is to apply liberal coatings of cellulose cement after the leather has thoroughly dried It is a good plan to wash the under surface of the leather to which the cement is to be applied with a solvent—petroleum ether is very suitable On no account must the insole be removed from the last until the cement is thoroughly dry If the insole is prematurely removed, the drying-out process of the cement will induce shrinkage and distortion.

It is possible to process surgical insoles of all types by this method, using the plaster cast as a base The use of casts is possible for this method because the leather is softer and can be moulded with much less stress than is required when using sole leather Beating is dispensed with, but the rubbing stick is still necessary to ensure a good firm texture and accurate moulding When dry, the exposed surface of the leather should be roughened with coarse sandpaper so that it will receive the cement readily Metatarsal depressions can be made by carefully marking the areas and then scouring or skiving the leather away until only a thin skin remains When the insole is removed from the last these areas can be pushed down from the upper surface, making clean smooth depressions to receive the painful pressure areas

Metal Reinforcement of Surgical Insoles

It has for many years been the practice to reinforce blocked leather surgical insoles by the means of metal, the materials most commonly used being steel pressings, aluminium or German silver Recently German silver and similar metals have not been used, and reinforcement is confined in the main to the use of steel or duraluminium

In the use of reinforcement of surgical insoles, one has to consider the object of the appliance If it is designed to provide a flexible support that will allow some degree of flexibility, the only satisfactory material is spring steel In the case of rest appliances of chronic cases where the object is to give firm support and stability and where the absence of

flexibility is not detrimental, the most suitable material is duraluminium because it is both strong and light Malleable metal may be used quite effectively, the only difficulty being the added weight

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Flexible Spring Steel Reinforcement

Spring steel is not a particularly easy commodity to obtain, but an engineer's shop can usually supply it It should be remembered that it is only a reinforcement and not the whole support, and should in consequence be light and well tempered One method of obtaining a supply of suitable material is to purchase an old clock spring or spring from a gramophone motor Springs varying from ½ in to ¾ in wide made from about 22 gauge metal would be suitable

The method employed by the author to fix this form of reinforcing strip is as follows cut a length of spring steel about ½ in to ⅝ in wide of sufficient length to bridge the medial arch To ascertain the required length, the strip of steel is bent against the medial arch of the plaster cast It should be held so that it passes beneath the first metatarsal under the navicular to the anterior aspect of the tuberosity of the calcaneum When the correct length is procured, it is held in the flame of a bunsen burner or blow-lamp until cherry red, the metal being grasped at each end by pliers When sufficiently heated, the metal is placed against the cast in the previous position and bent to the required curve and held in this position until it has cooled off and turned black The metal is again heated until cherry red and then plunged into oil The spring will now have regained its temper Should it be overtempered and brittle the temper can be adjusted by reheating The heat required this time should be only sufficient to burn off the oil again return it to the oil to cool and

this will adjust the temper of the metal, but it will have retained its curve The next stage is to drill two holes about ¼ in. from each end, also corresponding holes in the leather, after which the spring is secured in position by two aluminium or copper rivets This form of reinforcement will be found most useful and will add to the life of the appliance considerably The important point is to remember that the spring should be light and very flexible (Fig 69)

In the case of rest appliances requiring strengthening, a strip of duraluminium, about 22 gauge, will be very suitable

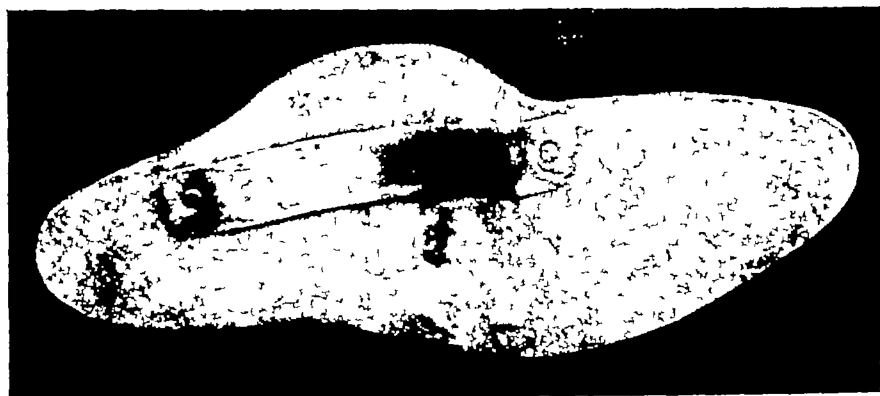


FIG 69

Blocked leather surgical insole re-inforced with spring steel

for quite a substantial support The metal is curved to fit the cast by gently bending with pliers and beating with a raw hide hammer until it fits the cast perfectly The metal strip is then drilled and secured in the same way as already described

It is interesting to note that the late Thomas Holland, well-known arch support manufacturer, claimed that his father invented the first arch support, which consisted of a block leather surgical sock with a metal spring reinforcement This appliance was first made and patented well over one hundred years ago

The Double Surface

A factor that is worthy of careful consideration is the im-

portance of stabilising the appliance in the shoe, as this must be achieved if the foot itself is to be stabilised

Whilst the superior surface of the appliance fits faithfully to the cast upon which it has been moulded, the inferior surface may present several protuberances and depressions which would seriously interfere with the proper stabilising of the appliances in the shoe by causing it to tilt and rock

This problem can be overcome by presenting a uniform flat surface to the floor of the shoe where pressure is received This can be achieved either by filling in the depressions until a level surface is reached, by using a compound of cellulose cement and cork fillings, or by using leather skivings secured with rubber solution A perfectly uniform surface can finally be obtained when the filling is set, by scouring with an emery wheel or sandpaper block.

It is also a good plan to square up the curved margin of the heel by the same method

CHAPTER X

THE WHITMAN BRACE

THIS corrective foot appliance was devised by Dr Royal F Whitman some fifty years ago The device is made of malleable metal, i e duraluminium and malleable steel or stainless steel, and consists of a medial flange and lateral flange piece which acts as a clip Unlike the standard arch support with a forward edge curving transversely across the heads of the metatarsals, the Whitman brace cuts obliquely across the foot from the base of the fifth metatarsal to immediately posterior to the head of the first metatarsal The absence of a heel seat is also a feature in which the appliance differs from other surgical insoles

The Whitman brace is unique in its corrective principles The patient is directed to place his weight on the lateral side of his foot which rests upon the appliance The resultant lateral thrust causes the appliance to tilt and raises the medial flange, pressing it against the inner side of the foot, and causing the foot to be drawn away from this point of pressure In this way the foot is caused to be drawn up into its normal contours, reforming the long arch The patient does not evert the foot, as to attempt to do so would cause considerable discomfort Any relaxation of the foot will again induce pressure from the medial flange, so that in effect the patient can only walk in comfort when the foot is held in the corrected position In this way the brace induces a corrective stance, and when walking the patient is in effect carrying out a compulsory corrective exercise The appliance has, therefore, a positive action in the physiological correction of pronation

The author suggests that instead of correcting a cast of the foot by rasping plaster away beneath the arch, a corrected cast be taken as for the corrective appliance technique

In shaping the appliance the medial flange should curve up to a point just beyond the tuberosity of the navicular In the

foot with a naturally low arch curve, however, it is advisable to bring the flange a little higher When making the brace the practitioner should start by taking a cast of the corrected foot This may be done either by the putty casting method or by slipper casting As the medial flange in this device extends well up the inner side of the foot, care should be taken in the case of putty casting to obtain a deep impression Whichever method of casting is used, correction should be obtained by inverting the heel, everting the forefoot and depressing the head of the first metatarsal When a satisfactory cast has been obtained, an outline of the shape of the appliance should be placed upon it, after which a paper pattern is cut to act as a template, which is used in marking out the shape of the appliance on the metal When the metal has been cut out in rough shape, it should be curved by the use of a mallet and lead block to fit the contour of the long arch of the cast This is achieved by a slow beating process When the metal has been beaten to the correct curve of the long arch, attention is paid to the lateral clip and medial flange A vice will assist in bending the lateral clip to some extent, but the medial flange can only be successfully moulded by the metal beating process

To ensure complete accuracy, frequent application of the appliance to the cast is necessary If the foot was correctly reformed to its normal contours during the process of cast taking, the finished appliance should stand firmly on a flat surface without rocking Any slight defect in this direction should be remedied Care should be taken to grind and polish the edges of the metal in the concluding stages of processing (Fig 70).

When fitting the appliance to the patient's foot, it should be clearly understood that correct functioning with the re-establishment of postural stability is not possible unless the footwear is suitable It is not likely that any degree of success will be achieved with the Whitman brace if its use is attempted in conjunction with unsuitable footwear The appliance must be able to seat itself and rest firm and stable on the insole of the shoe The heel seat should be adequate to take the weight-bearing heel, and the waist of the shoe should be sufficiently

wide to accommodate the appliance Proper width across the tread is also essential In other words, a shoe with the correct heel-to-ball fitting, taking into account the appliance, is what is required In the case of the Whitman brace as in other corrective appliances of this nature, replacement is necessary at appropriate intervals when used in the treatment of children

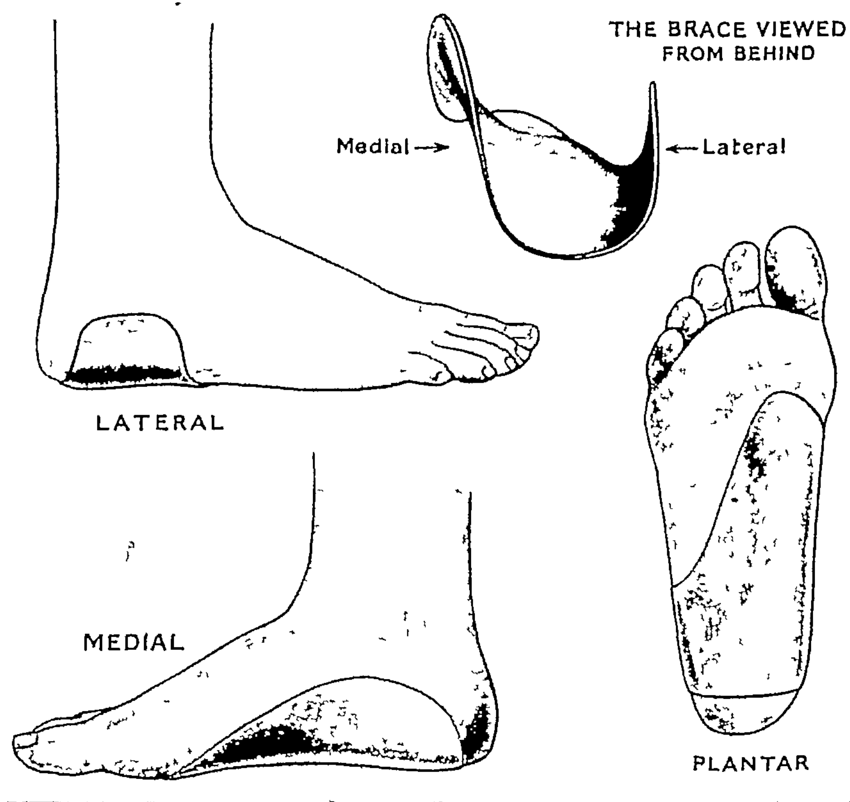


FIG 70
A Whitman brace

Just as footwear has to be replaced to accommodate the growth and development of the child's foot, replacement and adjustment is necessary in the case of all forms of corrective surgical insoles

Many modifications of the Whitman brace are made For instance, the appliance is made with a heel seat and with the anterior portion of the appliance extending behind the

heads of all the metatarsals as in the ordinary metal arch support

It may be noted that, when processing the appliance, duraluminium needs more careful handling than either of the other metals when moulding the flange and clip, as it shows a greater tendency to fracture if any attempt is made to hurry the processing Stainless steel may be used in gauge 16 with a fair degree of confidence, although gauge 20 is advocated in the case of malleable steel, and strongly advised when using duraluminium.

CHAPTER XI

SHOE THERAPY

IT is essential that the modern chiropodist should understand the basic principles of shoe construction and shoe fitting It is particularly important that he should devote some time to the study of footwear in relation to children's feet Many of the defects found in adults are the result of neglect in childhood. This does not necessarily imply that parents have been willingly negligent, but that proper advice and assistance were not available or the parents were not aware of such facilities

A survey of school children carried out by the author, with the assistance of a team of senior students, during 1946 and 1947 produced some interesting facts During the survey 5101 school children were examined, 20 schools being visited Every child was examined for the following conditions —

Defects of the longitudinal arch
Defects of the metatarsal arch
Lesser toe defects
Nail defects
Hallux valgus
Verrucae pedis
Corns and callosities

Footwear was examined and checked for size, fit and degree of serviceability Three standards were set for each condition —

"A" for satisfactory,
"B" for slight defect, and
"C" for marked defect

An analysis of the figures showed that the proportion of badly-fitting shoes in children entering school (aged 4 to 6) and children leaving school (aged 13 to 14) averaged about the same. It should be noticed, however, that the incidence of

defects in the feet was much higher in the older children, and that this applied to each type of defect No children, on entering school, were found with serious defects of the metatarsal arch, or with nail conditions, verrucae, corns or callosities A few instances of slight congenital deformities of the lesser toes were recorded, but the number of such cases was negligible Among the school-leavers, however, there was a very considerable incidence of all forms of defects The proportion of slight and marked defects was approximately the same Among the school-leavers corns and callosities were already in evidence Corns and callosities showed an incidence of 11 per cent, whilst hallux valgus revealed an incidence of 26 4 per cent, and defects of the long arch were even higher It is interesting to note the proportion of children with perfect feet at school-leaving was only half of those starting school, starters being 62 4 per cent and leavers 33 4 per cent

The collective figures on shoe fitting are most interesting Children wearing shoes one size too small—girls 26 9 per cent, boys 22 3 per cent Children wearing shoes at least two sizes too small—girls 10 3 per cent, boys 5 4 per cent The collective figures show that approximately 34 per cent of all children examined had footwear inaccurately fitted A large proportion of toe defects were the direct result of ill-fitting footwear and tight hose A recent investigation among adolescent secondary school children in a working-class district wearing footwear in sizes coming within the adult range (3 to 7) revealed an appallingly high percentage of severe defects of the lesser toes, advanced stages of pronated feet, and severe hallux valgus, whilst hallux rigidus with both early and advanced symptoms was encountered with disturbing frequency Percentages are often misleading and must not be accepted as dogmatic indications of general proportions Many factors tend to make percentages produced by survey misleading If a survey is carried out at a school in which the children were drawn from a good social environment, it is found that the incidence of serious defects arising from footwear of unsuitable type is considerably less than in the case of children brought up in a bad social environment It is

found that many of the latter are wearing footwear of most unsuitable adult types, and in many instances wearing the parents' cast-off and trodden-over footwear Nevertheless, making due allowance for such discrepancies, extensive and careful surveys carried out over long periods have established without question the fact that the most serious and permanent defects in children's feet are found to occur in disturbingly high percentages in the age group 12 to 16, 12 to 14 is included because the percentage in this sub-group is quite high, although it should be noticed that it is highest in the sub-group 14 to 16

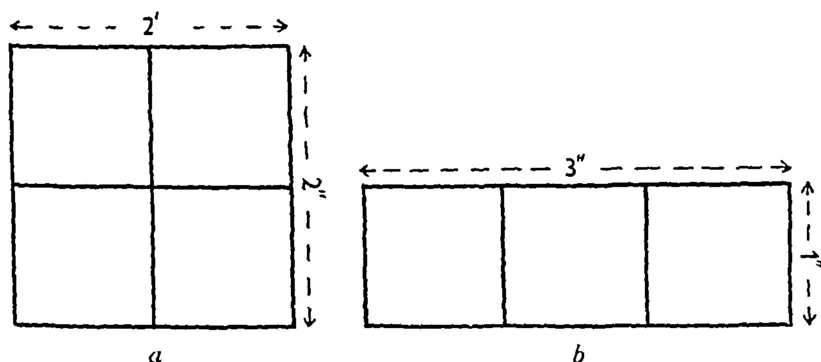
It has already been stated that in many cases defects in both feet and footwear are not the result of parental neglect, but lack of advice and assistance

A chiropodist with the necessary knowledge can do much to assist in placing both child and adult in sound stabilising footwear By this, it is not suggested that he should dabble in shoe retailing The chiropodist can best help by examining the footwear being worn by the patient, pointing out any inaccuracies or defects in type or fitting, and give advice on the type of footwear best suited to the particular needs of the patient Correctly designed footwear is fundamental in all shoe fitting Footwear should conform to the physiological and anatomical principles of the human foot, and therefore in designing footwear the natural function and stability of the feet should be taken into account Shoes should be designed to be complementary to these factors, exerting a corrective influence on feet showing structural and postural instability, whilst at the same time exerting no adverse effect on healthy feet

In taking measurements to clothe the foot, it can generally be accepted that the girth measurement of the foot does not determine the internal capacity The relative volume and shape is the real and essential factor Mr Wm J Peake, writing in *The British Chiropody Journal*, October 1947, ably illustrates this point by the following diagrams —

"It will readily be seen in the case of Fig *a* that the outside measurement or girth of this perimeter is 8 in, giving an internal capacity or area of 4 sq in In Fig *b* the outside

measurement is still the same as in Fig. *a* (8 in), but the internal capacity is only 3 sq in The measurements of both perimeters are exactly the same, the areas are different If these examples are exploited, it will be realised the variations that can be accomplished in footwear construction of any particular section, all measuring the same girth or external measurement, but giving different internal capacity The nearer any section of the shoe gets to a circle the greater will be its internal capacity or volume These examples are clear indication of the paramount importance of the distribution of the volume inside the shoe, or shape of the last upon which the shoe is made The last model maker must acquire the



intangible sense of size and form, the same sense which a sculptor possesses, combined with a structural knowledge of the foot"

It is an understanding of this fundamental relationship between the foot form and the shoe, supported by an understanding of the basic principles of structural and postural stability, that provide the foundation upon which the chiropodist can build in the field of shoe therapy

LEATHER

Origin of Leather

Leather was the first material used for the making of footwear, the skins of animals being scraped and stretched to cure them When dried, they were made into simple, soft slippers

by sewing them with sinews or thongs The earliest method of preserving skins was to rub in grease and oils The use of alum and the infusion of galls, vegetable matter and barks came much later Sole leather was introduced into England by the Romans, who used oak bark in its manufacture Leather dressing was probably introduced into Turkey by the Mohammedans, from whence these arts spread through Europe to England

A Definition of Leather

Leather is an animal skin which has been preserved from natural decay by the use of fats, oils and a variety of chemical agents, after the loose, scaly epidermis and hair have been removed

For the purpose of shoemaking, leather is the most suitable material ever produced It possesses many valuable qualities Not only is it strong, flexible and able to resist very severe friction and strain, but it is pliable, resilient, durable, light and, to a considerable degree, waterproof No other material has been produced as a substitute that combines all the estimable qualities possessed by leather Substitutes have, from time to time, been introduced for both uppers and soles Rubber-impregnated materials have been tried as a substitute for leather, and recently plastics have been added to the list All have proved very indifferent substitutes, and in many cases quite unsatisfactory None could bear comparison with the original shoemaking material

One of the primary defects in these substitutes is that they are non-porous The natural excretions from the tissues cannot be absorbed by these materials, and as a result condensation occurs and a reabsorption of toxic substances by the tissues takes place The condensation causes the skin to become moist and flaccid, resulting in maceration and blistering The porosity, or ability to breathe, possessed by leather enables the waste products to escape by evaporation and absorption into the leather

Whilst linen and cotton fabrics are porous, they are harsher to the skin and do not mould themselves to the form of the

foot so well as leather, also repeated wetting and drying causes considerable shrinkage and distortion

Enormous quantities of leather are used in this country in the making of boots and shoes It has been authoritatively stated that over one hundred million pairs are manufactured in Britain every year, all made with uppers of leather.

Tanning

This term, which originally only applied to the preserving of skins by the use of tannic acid, is now used in a more liberal sense to embrace the processing of all leathers, the names of the various substances used being applied to distinguish them

Types of Leathers

Almost any kind of skin can be made into leather The skins of reptiles and even fish are made into leather, but only a limited range of animal skins are in ready demand, the commonest of these being the bull, cow, sheep and goat Of the reptile skins, those of the crocodile, alligator and the lizard are most in demand Whilst it is common practice to name the type of leather after the reptile from which it is made, in the case of animal skins a considerable variety of leathers are made from the same hide or skin In the case of the ox, sole leather, leather for insoles and uppers are all processed from the same hide

It should also be noted that different tanning and finishing methods produce leathers widely different in appearance from the same skin

LASTS

Shoes are constructed on lasts which are the models, forms, or shapes over which the uppers are stretched, and determine the shape and cubic content of the shoe upon which they are made

The bespoke bootmaker makes his boots and shoes on lasts which are made to measurements of his customers' own feet, and which faithfully reproduce their form and individual

characteristics, whilst embodying such fundamentals as heel elevation, the raising of the heel of the last to accommodate the determined height of shoe heel and toe-spring. The old last makers were highly skilled craftsmen, who were able to combine a native skill with the eye of an artist in shaping these wooden forms with wonderful accuracy

In making lasts for mass-production shoes the last maker works to fixed standards of measurements and sizes, which have been determined as the result of much research and investigation It is generally claimed that these basic measurements are maintained irrespective of any variation in the shape of the last This, in effect, means that the total volume of wood in a last of a certain size and fitting will be the same, although its displacement may vary in the production of different last shapes to accommodate various types of feet

As hard pavements require modern shoes to have strong insulating soles which are relatively stiff, heels are introduced to assist in the take-off and also absorb some of the shock of impact in walking

The two extreme positions of the foot when walking are (*a*) when the heel contacts the ground, and (*b*) when the toes leave the ground in the last act of propulsion As stock shoes made for either of these extreme positions would not be satisfactory, a position between the two extremes is determined and is arrived at by designing the last to take a heel and by raising the toe of the last The latter is termed toe-spring These two factors assist in the take-off in walking

Whilst lasts have recently been made of other materials, lasts generally are made from wood A variety of hard woods are used, but lasts made from maple or hemlock are said to be the best Great care is taken in drying and seasoning the wood Kiln-drying is resorted to to prevent any possibility of shrinking and warping after the lasts are made

It has already been stated that the various sizes and widths are developed from basic measurements, and are then produced in basic models All sizes and fittings are graded from these Most manufacturers use three basic models, sizes 4, 6 and 8, with two or even three widths in each size

MEASUREMENTS

In measuring the foot we may be doing so with a view to making a pair of shoes, or with the object of building up a set of patterns for use in mass-production shoemaking It cannot be stressed too much that the strictest accuracy is necessary The graduations in sizes is extremely small, and

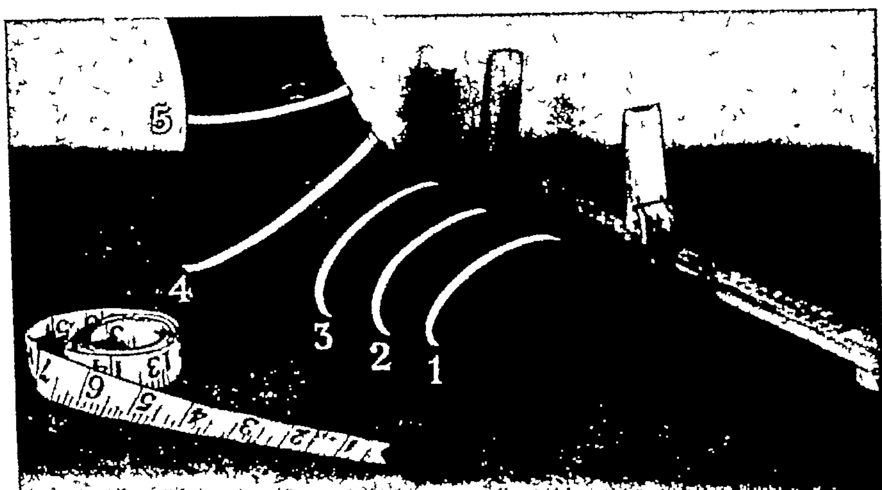


FIG 71

Showing the principal measurements, size stick and tape measure

1 Joint measurement
2 Waist measurement
3 Instep measurement
4 Heel measurement
5 Ankle measurement

in consequence even a fraction of variation in measurement is of great importance

The foot is usually measured at the following points, viz joint, waist, instep, heel and ankle The instep measurement may be supplemented by the Hass measure, which is sometimes termed the high instep The heel measurement is taken at two points, one measurement is termed the long heel and the other the short heel The ankle measurement is taken just above the ankle joint (Fig. 71).

Joint Measurement

The joint measurement is very important, and requires very careful application Various types of feet will show a

considerable variation in the angulation of the hinge formed by the metatarso-phalangeal joints In some feet it will be noted that the hinge is almost at right angles, whilst in others it will be markedly oblique The measurement is taken round the widest points on the first and fifth metatarsal heads

Waist Measurement

This measurement is taken immediately behind the first and fifth metatarso-phalangeal joints, and should be the smallest possible measurement that can be taken at this point

Instep Measurement

Two forms of instep measurement are in common use, one is to measure one-half of the length of the foot from the back of the heel, corresponding in height with the top of the instep This gives the point at which the girth of the instep is measured Another method is to take the measurement from a point located at the prominence of the internal cuneiform bone

Hass Measurement

This measurement, not often used nowadays except by a few old craftsmen, is taken round the instep over the posterior aspect of the navicular, and posterior to the cuboid

Long-Heel Measurement

This is another measurement that is now little used It is taken round a central point on the ball of the heel and over the prominence on the internal cuneiform

Heel Measurement

The heel measurement should be very carefully taken from the ball of the heel round the throat curve, which is the point anterior to the ankle joint, and at which it bends in dorsi-flexion of the foot

Ankle Measurement

It has already been explained that this measurement is taken round the leg just above the ankle joint

Leg Measurement

These measurements are always taken at carefully gauged distances up the leg from the base of the heel, and when quoted the measurement up the leg should also be given, along with the girth measurement at that point

Bespoke Shoes

Whilst the measurements just described are used in designing basic models from which the lasts for mass-production shoes are made, such measurements are also used in the designing of the individual lasts in bespoke shoemaking

As the old craftsmen have died out, the art of making these lasts has also gradually become almost a forgotten art, and in recent years most bespoke shoemakers have resorted to the modifying of stock lasts to their customers' measurements, unless the defects in the feet amounted to severe deformities When the modifications required are excessive the alteration of stock lasts is out of the question In this event, casts of the patient's feet are usually sent up to the last maker so that a special pair of lasts may be made to the required form and measurements For many years the author used stock lasts of this type as a basis for designing lasts to the measurements of his patient's feet The technique was to use lasts of a suitable shape and pitch, but much oversize so as to provide ample volume of spare wood upon which to work With measurements, drafts marked with both dorsal and plantar defects, contour drawings and casts the lasts were reduced to the proper shape and measurements by using the scouring wheels on a shoe finishing machine, rasps, sandpaper, etc. Occasionally plastic wood or leather were resorted to for very local adjustments These lasts, which became the property of the patient, proved a boon to a great many of them, and footwear made on these lasts proved a major contribution to successful treatment

Specials

Many of the high-grade shoe manufacturers provide a special service for their customers or agents This service consists

of modified stock lasts to measurements submitted and the making of special shoes upon these lasts The shoe retailer selects a size, shape and fitting from stock as near as possible to the requirements of his customer The next step is to take drafts, marking any defects such as dorsal and distal corns, bunions, exostoses, etc

The feet are now measured, a modification of the full range of measurements is used, usually shoe size, ball, instep and heel only being taken, except when boots are required, in which case the ankle measurements are given This system has proved very beneficial to many foot sufferers, and it is most desirable that some form of liaison between the shoe retailer and the orthopædist or chiropodist should be established whereby footwear requiring only minor alterations could be made in this way without resorting to the fully-fledged bespoke shoes

This system is particularly useful for women patients as the appearance of such shoes are invariably more presentable than bespoke shoes It should, however, be remembered that this system is only useful when minor alterations will meet the case, such as a little fitting on a joint, a little more depth for the toes, generally, or over a hammer toe in particular The curvature of the long arch may be increased by scouring out the required amount of wood, but care has to be taken to retain the correct girth measurement of the instep by adding new material in the form of plastic wood or leather to the top of the last when necessary

THE FOOTWEAR OF THE CHILD

It is believed by many that all children are born with perfect feet, which are subsequently distorted and weakened by footwear This is a false assumption Some children are born with structural defects, and most children in a civilised community have feet that pronate to some degree when standing. If the child born with sound, healthy feet could be kept without shoes and brought up in an environment of springy turf and soft sand during the pre-school years, structural

and postural stability would be assured, provided that on commencing to wear shoes they were based upon sound anatomical and physiological principles As the modern child usually commences active life in the environment of unyielding wooden floors and later hard, stony or concrete pavements, development of the intrinsic muscles is retarded As these conditions are part and parcel of a civilised existence, it is a practical policy to assist the child in developing sound, modern feet by fitting appropriate footwear at an early age to assist in establishing and retaining structural and postural stability If this principle is accepted, it will be agreed that the best time to fit the child with appropriate footwear is when the first steps are taken towards assuming an erect posture

The efficiency of the modern foot is dependent on its ability to act effectively as a lever, and its efficient functioning in this capacity is dependent on a semi-rigid tarsus and a sound and massive first metatarsal segment

If we are to accept the modern foot with its more or less rigid tarsus as a normal standard, footwear with a flexible shank cannot be approved A sound shoe for a child is one which firmly supports the tarsus Such a shoe requires a rigid shank and adequate length to accommodate the growing foot The shoe should be based on a fitting from heel to ball This means that the waist of the shoe should fit snugly under the instep to immediately behind the heads of the metatarsal joints

The stability of the first metatarsal segment is impaired by any of the common anomalies which affect the first metatarsal bone (i e shortness, hypermobility or varus inclination), so that the anterior medial corner of the foot tripod is weakened and the foot tends to pronate Sound footwear should take account of this tendency and should ensure the effective positioning of the first metatarsal segment in the shoe so that a postural stability is established

The Heel-to-Ball Fitting

By this system shoes are fitted to the arch length The foot is measured on a scale in which the shoe size coincides with

the level of the ball joint In this method of shoe fitting the shoe length from heel to ball coincides with the foot length over this area, the joint resting in the widest part of the shoe, and the metatarso-phalangeal joints or the hinge of the foot coincide with the hinge part of the shoe (Fig 72) In this form of fitting, toe length is taken into account, and is provided

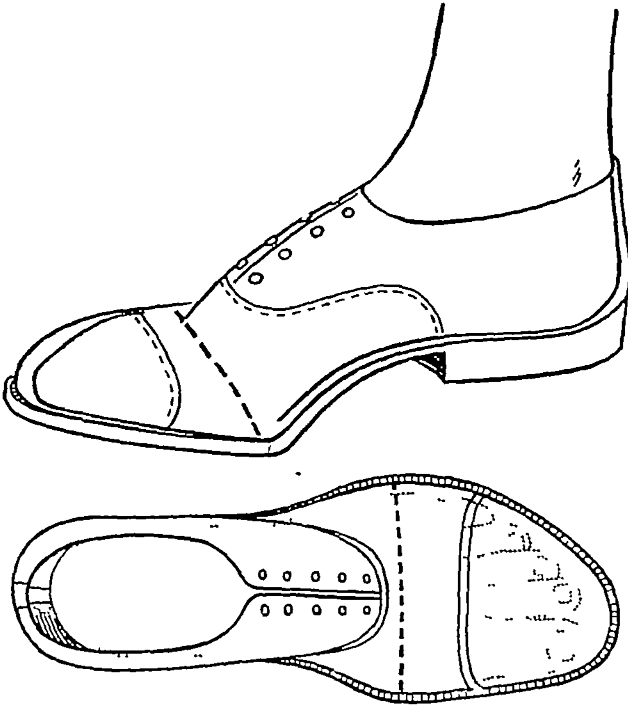


FIG 72

Illustration showing transparent view through shoe of the relationship between the hinge of the foot and shoe

for in the fitting range Adequate length and joint fitting are essential, because on weight-bearing some degree of lengthening of the foot takes place, with a degree of spreading across the metatarso-phalangeal area Short shoes will cause injury to nails, whilst back pressure on the end of the great toe can seriously damage the first metatarso-phalangeal joint Shoes which are too narrow across the tread will cramp the foot and impair muscle function, leading to loss of muscle tonus and atrophy

The shoe should be closely tailored around the heel and the instep. The heel fitting should be close and snug, including the corseting of the sub-taloid joint (Fig 73) Whilst the shoe should fit closely round the heel and instep, there should be full and ample joint fitting and complete freedom for the toes so as to allow, as far as is possible in footwear (Figs 74 (*a*) and (*b*)), a satisfactory positioning of the first metatarsal



FIG 73

These shoes are correct at the joint instep, heel and ankle

By courtesy of British Boot, Shoe, and Allied Trades Research Association

segment, and the maintenance of postural stability As the foot of the child has not yet been distorted by shoes, every endeavour should be made to clothe the foot in shoes that conform to the natural contours

A child's foot differs from that of the adult in its anatomical development In the child's foot there is considerable spacing between the articulations of the joints, and in a very young

child there is a lagging in the development of the mid-tarsal segment in relation to the rest of the foot structure Because of these factors, it is very easy to fit a child with a shoe that is very much too short without the child actually suffering pain The greatest care should therefore be taken to see that adequate length is provided (Fig 75) By most authorities adequate length means $\frac{3}{4}$ in beyond the length of the longest toe The term "longest toe" is used because there are many cases in which the longest toe is not necessarily the great toe When a



a b

FIG 74

Toe shape

For Boys — A good shape A bad shape

For Girls — A bad shape A good one

By courtesy of British Boot, Shoe, and Allied Trades Research Association

child is firmly established on its feet, the toe extension may be reduced to $\frac{1}{2}$ in, as excessive extension may do more harm than good, leading to faulty gait and imbalance It is also essential that measurements should be taken with the feet weight-bearing, and standing with them 6 in apart Measurements taken in this way allow for hypermobility and extension

Children outgrow their shoes within four to five months, and it is therefore advisable that systematic checking of the foot measurements in relation to shoe size should be carried out at regular intervals of not more than three months (Fig 76)

In clothing the foot of the young child, that is a child up to about $2\frac{1}{2}$ years of age, boots rather than shoes are advisable This is not advocated, as some might think, to support the



FIG 75

Showing toe line in relation to the shoe

a Correct length *b* Too short

By courtesy of British Boot, Shoe, and Allied Trades Research Association

weak ankles, but because the mobility of the joints and the simple architecture of the foot of a very young child make it difficult to keep a low shoe on the foot, let alone retain it in

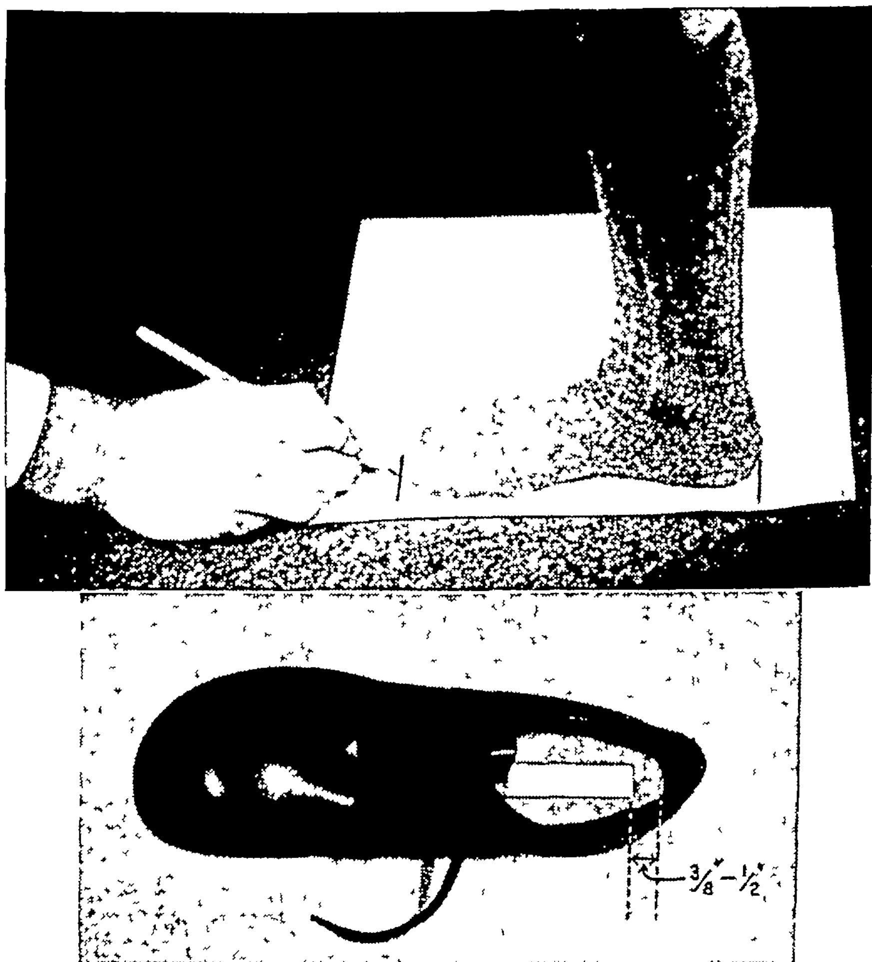


FIG 76

Checking the length of a shoe

To make sure the shoes have not become too short, have the child stand barefoot on a piece of cardboard With a pencil put one mark at the end of the longest toe and another at the back of the heel Cut out a strip of the cardboard about ½ inch wide, between the two marks Insert the strip in the inside of the shoe and when one end of it is pushed up to the toe, the other end should be at least ⅜ inch to ½ inch short of the back of the shoe

By courtesy of British Boot, Shoe, and Allied Trades Research Association

close proximity to the instep and ankle, providing the stabilising support that is necessary. It is the boot rather than the shoe that can be most successfully secured on a child's foot Dr H R. Tax in his book *Podopediatrics* ably disposes of the weak ankle theory for boots by stating ankle motion is of a hinge joint variety and its principal motion is flexion and extension The so-called "weak ankle" or "double ankle" is not weak ankle at all, but a weakness of the foot called pronation This movement (pronation) consists of a rolling inwards and downwards of the foot, and takes place at the sub-taloid joint which lies below the ankle Most Oxford shoes are so built that they cover this joint completely, giving it support. The need for the higher shoe, therefore, is not at all one for added support for the foot Support for the foot is directly dependent on the bottom and inner border of the shoe, and the Oxford (low shoe) fills this requirement as well as the boot

It is to retain the bottom and inner border in close proximity to the foot in the very young child that boots rather than shoes are advocated After the child has reached 2½ years of age, however, shoes may be introduced as a satisfactory form of footwear

Rigid Shank

Reference has already been made to the importance of the rigid shank in the shoe which clothes and supports the modern foot Unlike the primitive foot, which was a more flexible and mobile structure, the modern foot has of necessity become more compact, and the tarsus more rigid to form an efficient lever The limitation in adduction of the great toe and first metatarsal segment in shoes and hose results in a narrowing of the base of the triangle of stability

In this way the most important prop of the medial arch is weakened, and a rigid shank is necessary to provide some compensatory if inadequate support

We must always have in the forefront of our minds the fact that the child is in the unnatural environment of hard, unyielding floor surfaces, as against the ideal one of springy turf, soft sand, etc

Whilst the waist of the shoe should be stiffened by the use of the rigid shank, the hinge movement of the metatarso-phalangeal joints should be accommodated by a flexible sole that bends truly at this point

FOOTWEAR OF THE ADULT

In approaching the subject of adult footwear, one has to consider feet which are mature, having assumed their final form and characteristics, also, in the great majority of cases permanent structural defects have to be taken into account

It will be found on careful study that the feet can be classified and placed into various type groups, whilst functional classification is also not only possible but very necessary The classification of feet in this way plays a vital part in the scientific fitting of shoes In fact, it is the object of the expert shoe fitter to select and fit footwear of a type suited to the form and functional type of the customer The chiropodist may not be selecting and fitting the actual shoes for his patient, but it is of very great importance that he is able to recognise the characteristics of his patient's feet, and accurately assess the degree to which the footwear does or does not measure up to requirements

It is already acknowledged that a great proportion of minor deformities are acquired as the result of wearing ill-fitting footwear over a long period of time Whilst in many cases the patient has not been aware of any discomfort associated with the abnormality or deformity, he is painfully conscious of secondary lesions due to postural instability arising from deformity

Foot Types

It is most interesting and instructive to study our patients' feet, not only as a means of diagnosing lesions and abnormalities but as a means of classifying them into the various types and functional classes

In the course of our study we shall observe the long narrow foot, often with the toes falling away at a very oblique angle

from the second to the fifth This type of foot is frequently thin, with only a limited amount of padding. We may then observe what is often erroneously regarded as the normal foot, with its pleasing lines and apparent good balance beneath length and joint width, and the nice curve of the toe line as it falls gradually away from a second that is slightly longer than the first to the fifth toe. In due course we will be sure to encounter the short plump foot This foot is short, broad and well padded The tips of the toes are usually set in an almost straight line from great toe to the fifth

These are three basic types that are regularly encountered, variation in degree will, of course, be found in each type, but the basic types are as such easily recognised We will meet a varying degree of arch elevation, from a medial arch with a very pronounced curve to a foot in which the arch is very shallow These variations in character are testimony of the fact that we each and every one of us individually possess distinct features of form and character

The various factors described in relation to the different foot types are merely features of the individual All are normal unless some development occurs that impairs function —all such developments may be classified as abnormal

Function

Having considered foot types, we must consider function and classify feet accordingly We have the flaccid foot which on weight-bearing flows in all directions This type of foot has a very great degree of flexibility We have the type of foot which has a degree of flexibility that provides for an adequate degree of movement, but its range of flexibility is not exaggerated This again is the type that we are apt to regard as the normal Again, we can classify a further type that may be termed rigid this type has an extremely limited range of movement We may meet this condition in the obese oedematous type or in the thin bony foot associated with senile degeneration

It has long been realised that when advocating the heel-to-ball fitting system for shoes, anomalies did exist which when

met with would militate against a satisfactory fit The abnormally long second or fourth metatarsal are examples that are encountered from time to time It is found that in such cases the hinge movement of the shoe across the tread in a line from the first to fifth metatarsal is impaired, and so brings excessive friction and pressure to bear upon the prominent metatarsal, which is depressed by back pressure on the end of the toe in many cases

A factor that is important is that of the tight tendo Achillis, a condition that may be congenital or acquired The wearing of very high heels over a prolonged period of time will produce the objective symptoms of short tendo Achillis, although the condition is more frequently one of shortening of the calf muscles In such cases the patient will have no difficulty in carrying out a normal range of movement in plantar flexion, but it will be found that the range of dorsiflexion is very limited or entirely absent, the patient being unable to move this foot beyond a position at right angles to the leg This case has its own special problems to be dealt with when fitting shoes The acquired short tendo Achillis is almost invariably a defect of women, although the congenital condition is met with in males

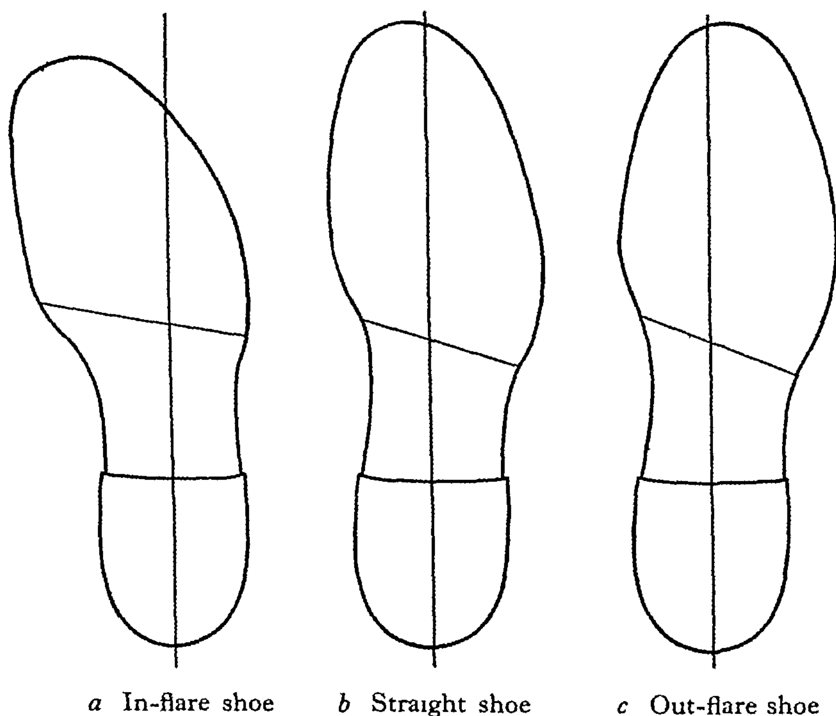
Flare Factors

When referring to "flare" we mean the in-swerve or out-swerve of the forefoot as a natural characteristic

The question of relationship of flare of feet and shoes has come into considerable prominence of recent years, and much thought has been expended on this factor by many orthopædic surgeons, chiropodists and shoe fitters It must be conceded that in the main natural feet have a tendency to in-flare, whilst a degree of pronation will induce valgus deviation of the forefoot, which may in consequence be classified as an out-flare foot Between these two deviations we have the foot that is straight

In the case of the middle-aged or elderly adult, a valgus forefoot will not be easily corrected, and the out-flare tendency has to be taken into account As most adults have acquired

quite a reasonable degree of hallux valgus, the in-flare factor will seldom arise A study of the foot of the adult, particularly the feet of women, will reveal the fact that the forefoot of many have assumed a conical form due to the wearing of tight hose or shoes of that shape, and here we are brought back to the straight shoe The straight foot and out-flare foot are in the main the result of acquired deformity or weakness The in-flare foot, unless deviated to the degree of a deformity, is the



a In-flare shoe *b* Straight shoe *c* Out-flare shoe

FIG 77

somewhat rare case in the adult, an approach to the natural foot It is important that these tendencies be noted and taken into account in shoe fitting (Fig 77)

Classification of foot types should not be concluded without some reference to the relationship of heel and joint Whilst many feet show a relationship of heel and joint size that conforms to the average of fittings carried by the shoe store, a considerable number of feet are encountered with a narrow heel and a wide joint Feet of this type require equal care in

the fitting of the heel as of the joint, if the shoe is to remain comfortable and the foot retained properly seated in the heel of the shoe The foot with a wide heel and narrow joint is a much rarer type, but it is equally important that special consideration should be given to the heel fitting

An effort has been made to provide a limited range of heel fittings, as well as joint fittings, in mass-produced shoes of good makes, but a full range carried by retail shoe stores would involve a considerable outlay in stock, much of which in the case of the fittings in little demand means an appreciable amount of capital locked up in stock with a very slow turnover The result is that the retailer is tempted to carry only a skeleton range, with the object of fitting the majority from stock and ordering the special fittings as required

Shoe Fitting

In measuring the foot for stock shoes the measurement should be taken while weight-bearing The reason for this is to provide for the natural spread of the foot when weight is placed upon it, whilst elongation to some degree will be encountered The instrument used for this purpose is a standard size stick, which is a boxwood rule marked off in sizes and half-sizes from infant's to men's At the base of this size stick is a stop against which the back of the heel will rest, another stop is fitted with a metal clip fixing it on to the stick, but permitting it to slide freely up and down

To take the measure, the foot is placed on the size stick with the heel against the fixed stop The movable one is moved along the stick until it is touching the great toe, except in cases where the great toe is not the longest, and then it should rest against the longest toe Cases are met with where the second toe is the longest, and in much rarer cases another of the lesser toes Such cases, of course, complicate the process of fitting shoes

In last design, allowance is made for a reasonable toe clearance which is about the equivalent to two sizes over the actual foot size It is therefore necessary to allow two sizes over the size shown on the measure when the foot measurement is

taken Some manufacturers design size sticks with the required allowance provided, but in such cases this measuring instrument will only be reliable when used in conjunction with the makers' own shoes Frequently manufacturers design a special range of lasts and size gradings accompanied by a measuring system requiring a special machine, which they have designed expressly for the purpose of accurately incorporating the foot measurement into the particular size and fitting required in their own particular range of shoes No objection can be taken to this method of fitting stock shoes, provided the use of the measuring instrument is confined to the fitting of the particular footwear for which it was designed The heel-to-ball principle of shoe fitting can be taken as being accepted as the most satisfactory standard method Certain principles should be followed out in the fitting of shoes which can always be applied irrespective of any variety of fitting systems

Adequate allowance should be made for the foot when weight-bearing to have ample length for toe clearance Sufficient depth in the toe box is also necessary This point is most important when the toe tends to hyperextend Another important point is to see that the heel-to-ball fitting of the shoe is correct The heads of the metatarsals should seat accurately on the hinge of the shoe sole when the heel of the foot is placed snugly back into the heel of the shoe The joint fit should be such as not to constrict the foot on weight-bearing, whilst not allowing undue surplus material across the vamp to form creases When laced, the fastening should tend to hold the foot back into the heel seat of the shoe The upper should lace evenly and should not quite meet when properly fastened When laced, the shoe should feel to corset and brace the instep and clip snugly round the heel, and the shoe should have been made on a last that conforms as near as possible to the foot type of the patient

Shoes made on the straight-inside edge principle should be approached with caution in the case of the adult The straight-inside edge last is really a fully in-flared shoe based on the natural foot, and few adult feet will be found to conform to the shape of this last A modification of this type of shoe

is also made with a slight eversion from the centre line which will, in consequence, fit a correspondingly greater number of adults It will be found that in the great majority of cases the best shaped shoe is one in which the medial line of the forepart of the shoe deviates outwards to a noticeable degree, and in which the lateral curve follows a normal toe line, in other words, a shoe with a slightly everted medial line, but without a corresponding outward deviation of the lateral line, that is to say, short of being an out-flare shoe The reason that a last of this type is suggested as conforming to the requirements of the greater number is that surveys have shown that in the average adult foot the anterior metatarsal area has spread but the toes have been retained in a more or less crowded position Correction is not as a rule very hopeful, but adequate accommodation for the foot as it is, frequently proves the best line of approach Many chiropodists have met patients with a gross valgus deviation of the great toe with a considerable exostosis, yet the joint was freely movable, and no discomfort experienced unless the joint was impinged upon Patients are met with who have burrowing fifth toes, in which the same principle applies It is, in the opinion of the writer, a much sounder policy to treat such feet by prescribing shoes that fit snugly round the heel and instep, giving a firm bracing effect, whilst using a last with a forepart shape that allows adequate room for the joints and toes, yet conforming reasonably accurately to the shape of the foot The fitting of adult feet requires the application of a great amount of common sense (Fig 78)

Instances have come to the notice of the writer where the practitioner has endeavoured to apply corrective treatment to a case of hallux valgus with chronic bunion by the fitting of a shoe made on a straight-inside edge last Needless to say that as a corrective treatment the fitting of such shoes was a dismal failure Hallux valgus in a middle-aged person has come to stay, likewise the exostosis accompanying the chronic bunion In the shoe referred to, the toe still retained its valgus deviation, leaving an empty space on the medial side of the toe box and vamp which quickly resulted in an ugly crease on walking and caused an abrasion on the dorsal aspect of the proximal phalanx

of the great toe The valgus displacement of the toe causes a like tendency in the lesser toes, resulting in a severe impingement on the fourth toe by the lateral border of this in-flare shoe

Bunion Shoe

The common-sense and more successful line of approach would have been to fit a bunion shoe This type of shoe was first made on the assumption that the big joint fitting required corresponding roominess elsewhere It was soon realised,

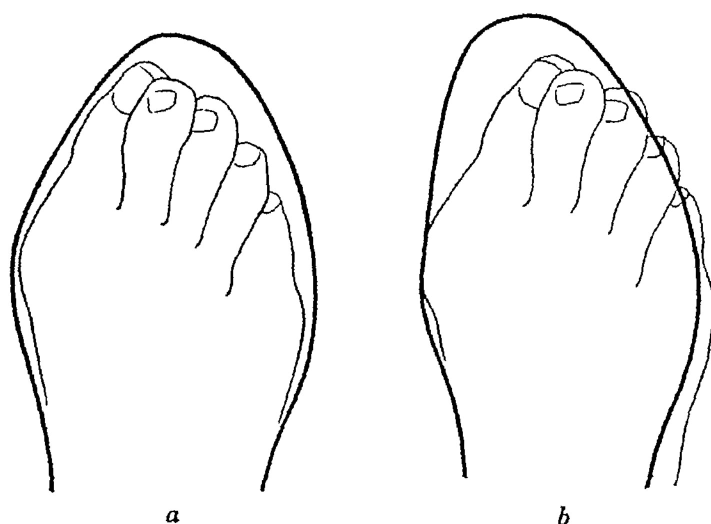


FIG 78

a Outline of shoe properly related to the grossly deformed foot *b* Outline of natural form shoe over the grossly deformed foot

however, that when a shoe was fitted that did not snugly embrace the instep and heel, the foot tended to creep forward in the shoe during wear This resulted in a crowding into the fore part and an aggravation of the existing defects The lesser toes were forced back and the valgus deviation of the great toe increased The enforced subluxation of the metatarso-phalangeal joints usually induced symptoms of metatarsalgia. It is now realised that the patient with metatarsal spread and a chronic bunion frequently requires a small heel fitting, and shoes of this type are now produced The bunion shoe properly fitted would conform reasonably well to the form of the foot and accommodate the joint If a snug heel and instep

is also made with a slight eversion from the centre line which will, in consequence, fit a correspondingly greater number of adults It will be found that in the great majority of cases the best shaped shoe is one in which the medial line of the forepart of the shoe deviates outwards to a noticeable degree, and in which the lateral curve follows a normal toe line, in other words, a shoe with a slightly everted medial line, but without a corresponding outward deviation of the lateral line, that is to say, short of being an out-flare shoe The reason that a last of this type is suggested as conforming to the requirements of the greater number is that surveys have shown that in the average adult foot the anterior metatarsal area has spread but the toes have been retained in a more or less crowded position Correction is not as a rule very hopeful, but adequate accommodation for the foot as it is, frequently proves the best line of approach Many chiropodists have met patients with a gross valgus deviation of the great toe with a considerable exostosis, yet the joint was freely movable, and no discomfort experienced unless the joint was impinged upon Patients are met with who have burrowing fifth toes, in which the same principle applies It is, in the opinion of the writer, a much sounder policy to treat such feet by prescribing shoes that fit snugly round the heel and instep, giving a firm bracing effect, whilst using a last with a forepart shape that allows adequate room for the joints and toes, yet conforming reasonably accurately to the shape of the foot The fitting of adult feet requires the application of a great amount of common sense (Fig 78)

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that when the sole is in proper relationship to the ground, the heel of the last is elevated the correct amount to take the shoe heel This relationship of heel height and the pitch of last is most important It is, of course, necessary to increase the toe

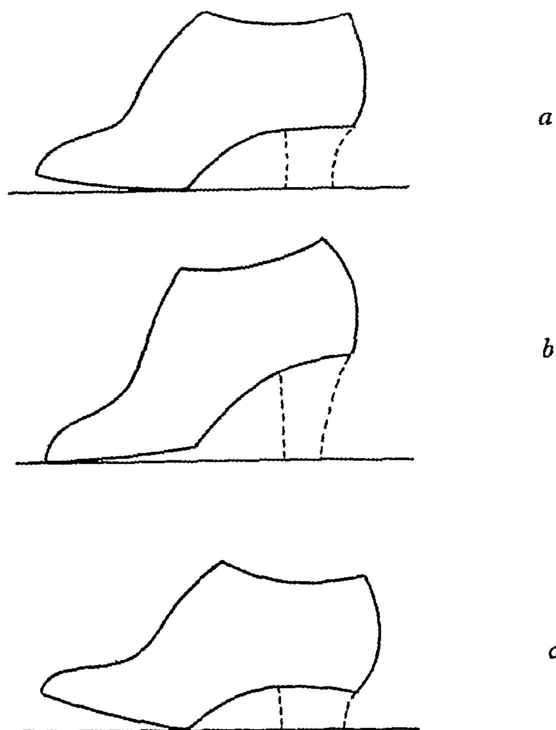


FIG 79

Relationship between pitch of last and height of heel *a* Correct pitch of last when supported on heel of correct height Note the space between the floor and the sole of the last which is designated the "toe spring" *b* Effect on pitch of last if too high a heel were fitted In this instance the clearance provided by the toe spring is eliminated by the abnormal tilt of the last *c* Effect on pitch of last if too low a heel were fitted, resulting in backward tilting of the last and exaggerated toe elevation

spring in relationship to the increased height of the heel, and the curve of the waist will be proportionately exaggerated, and the last will be correspondingly shortened. As the heel is made higher, the pitch of the shoe is increased, and the curve of the waist correspondingly accentuated (Fig 79) This will

fitting is achieved, the result will be real comfort for the patient Correction will not result, but it is rarely possible in such cases except by surgery, and a worsening of the structural defects will be arrested, while the absence of any impingement will render the bunion more amenable to treatment if inflammation is present

THE RELATIONSHIP OF HEEL AND LAST

The heel, provided that it is of modest height, plays a useful part under modern conditions in receiving the first shock of impact and provides a cushioning and shock-absorbing medium This can be more particularly said of men's shoes, although women's shoes with a heel up to 1½ in may be included, provided that the top-piece has a good surface area

It should be understood that in good shoes there is a perfect relationship between the heel and the shoe, as the former will have been designed expressly for the shoe to which it is to be fitted Where the shoe and heel are correctly related, weight distribution is properly balanced and the weight received in the shoe heel is passed through its centre The higher the heel the greater is the mal-distribution of weight likely to be, and in the very high heel the greater proportion of weight-bearing is transferred from the heel to the ball of the foot

When heel heights are being considered, the location of the centre of transmitted weight must be borne in mind In standing barefoot, the centre of transmitted weight falls within the tarsal area, but as the heel is raised the weight is transferred further forward With a heel height of over 1¾ in the centre of transmitted weight passes from the tarsal to the metatarsal area

Last designers have endeavoured to overcome this tendency, but there are distinct limits to what can be achieved even by the best craftsmen As already mentioned, this problem mainly applies to women's shoes, and in giving consideration to the fitting of shoes to women the question of type of heel is a most important one The last is designed to take a definite height of heel This is referred to as the pitch of the last, which means

In a shoe made with this feature, the welt is carried right round the heel The result is that the heel counter actually sits inside the heel seat, the shoe heel being correspondingly broader This gives perfect stability both by the fact that the heel counter does not overhang the heel, and because of the increased surface area of the heel

Another feature that can still further support and stabilise the feet is to float or buttress the heels This in effect means that the heel gets gradually wider towards the top-piece, giving a buttressing effect, which makes for real stability. One has only to wear shoes incorporating either or both of these features to realise the distinct improvement over other shoes

SURGICAL ALTERATIONS TO SHOES

Wedges

Wedges are used to produce a tilting of some part of the floor of the shoe to alter the flow of weight distribution through the foot The wedge should not be placed on the top of the sole or heel of the shoe but should be placed between the middle sole or the base of the heel respectively, so that the plane of the sole or heel surface itself in relation to the ground is not altered The heel wedge should extend the whole width of the heel and should be a true wedge graduated down to a feather edge at its thinnest point The wedge so inserted into a shoe between the heel and the heel seat will produce an angulation of the heel seat in relation to the heel.

Wedges are sometimes placed on the top of the heel or sole The result is that there is not a uniform tilt, but an abrupt angulation at the midline which is not so effective in its results Also, such wedges wear away very quickly and thus rapidly lose any corrective effect which they may possess, whilst repeated replacement is both costly and inconvenient When a sole wedge is to be used, the sole should be detached from the welt or middle sole and the wedge inserted between them In this way the proper tilt is achieved and the plane of the sole in relation to the ground remains unaltered, and as in the case of the inserted heel wedge, the wedge does not become worn

result in a high-heeled shoe being shorter than a low-heeled shoe of the same size. If the last is well designed, however, and the shoe fitted with a heel made expressly for it, the toe of the foot will still have the proper clearance. This, however, is only the case where the upper of the shoe is well designed and holds the weight-bearing foot firmly back, with the heel fitting snugly into the heel seat of the shoe If the foot is reasonably flexible, a fair degree of stability can be maintained in a dress shoe with high heel if only worn for short periods, and if so worn no serious damage to the foot structures will result If the shoe is a good fit the heel will be well seated, and the snugly-fitting rigid waist will press against the plantar surface of the instep, helping to disperse weight and preventing it all being taken by the ball of the foot The real strain will be in endeavouring to maintain lateral stability It is the lateral stability of the foot that is most affected by shoes of this type, even if well designed The top-piece of a heel 2½ in. to 3 in high is usually very small—probably little more than 1 in across, and often less The waist of such shoes is also very narrow, only the central portion of the instep resting upon it, with lateral and medial portions being contracted by the upper The tread is also quite narrow. An endeavour has been made to accommodate the foot by providing compensatory depth Whilst the extra depth may compensate for the part of the foot that should spread transversely on weight-bearing, it prevents the intrinsic muscles functioning and undermines the stability of the anterior transverse arch, or, in other words, the base of our triangle of stability.

In the normal healthy foot, the lower and broader the heel, the greater the degree of stability In the case of the tight tendo Achillis, the heel should be of sufficient height to allow the heel to become properly weight-bearing without strain on the tendon, always remembering that the broader the bearing surface of the shoe heel the greater is the degree of stability.

In the substantial types of sports shoes and walking shoes for both men and women, support and stability can be still further increased if the following features are incorporated. Firstly, we should consider the benefit of the welted heel seat

extension should be on the medial side The best guide would be that the extension should be between the tuberosity of the navicular on the medial side and the anterior margin of the malleolus on the lateral side, the thickness of the wedge varying between $\frac{3}{16}$ in and $\frac{3}{8}$ in The lateral heel wedge is not so frequently used, and is mainly employed for conditions usually designated weak ankle, which repeatedly turn over when walking on uneven surfaces The lateral wedge is also used in conjunction with a lateral Thomas heel mainly for talipes varus.

Buttressed Heel

Heel wedging is also utilised in conjunction with buttressed heels The buttressed heel is particularly helpful in ensuring stability, and is most beneficial when used with both medial and lateral heel wedging (Fig 81). A combination of lateral Thomas heel with wedge and buttress is frequently used most successfully in the establishment of stability in cases of talipes varus, although in some cases the heel extension is carried forward to a greater extent, frequently filling in the whole of the waist on the lateral side The author has almost invariably utilised a lateral buttress in conjunction with stabilising surgical insoles

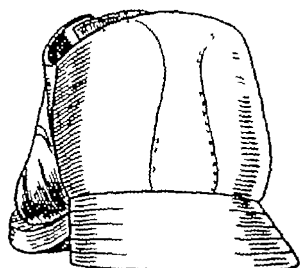


FIG 81

Drawing of shoe, showing heel with lateral buttress

Sole Wedges

The medial sole wedge is occasionally used in conjunction with the medial heel wedge in cases of genu varum and genu valgum, but it is often found more effective where the waist is filled in on the medial side and the wedge carried through as a continuous wedge from heel to toe, Thomas wedge

The lateral sole wedge, however, is used frequently in conjunction with the medial heel wedge in the treatment of pronated foot The use of the lateral sole with the medial heel wedge in a treatment of this condition is to introduce the

and therefore retains its corrective influence whilst it remains in position

Heel Wedge

The medial wedge is the one most frequently fitted, being used in foot strain and the milder degrees of pronated foot Its object is to tilt the floor of the heel seat and by so doing re-align the calcaneum with the tibia The degree of wedg-



FIG 80

From left to right—Thomas wedge, Thomas heel and Thomas bar

ing is governed by actual requirements, dependent on the severity of the case and the degree of angulation of the calcaneum to the tibia The actual thickness required can be ascertained by the insertion of experimental wedges beneath the patient's heel This form of wedging is sometimes carried out in conjunction with the Thomas heel The Thomas heel has already been referred to elsewhere This is sometimes referred to as an extended heel, the extension being approximately $\frac{3}{4}$ in (Fig 80)

In connection with the wedging already described, the heel

twist or stabilising effect appears to have been achieved cannot be too strongly stressed The thicknesses of these wedges are then measured and wedges of corresponding type and thickness fitted to the shoe This will avoid to a great extent a blind trial and error technique

It is important that the patient, or in the case of children the patient's parents, should be made fully conversant with the objects which the practitioner is trying to achieve. Intelligent understanding on the part of the patient of what the practitioner is endeavouring to do will induce a more ready co-operation and a better understanding of the necessity of frequent visits often attending this form of treatment in its early stages

TRANSVERSE AND LONGITUDINAL BARS SOLE EXTENSIONS AND PLATFORMS

Metatarsal Bar

The metatarsal bar, or Thomas bar, is probably one of the oldest and most common methods of treating defects of the anterior transverse arch The original Thomas bar consisted of a bar of leather fitted to the sole of the shoe, and so positioned as to lie obliquely across the sole immediately posterior to the heads of the first and fifth metatarsal bones The bar, which was about $\frac{1}{4}$ in at its anterior margin and about $\frac{3}{4}$ in wide, is kept on the same plane as the sole by building it up with a wedge piece Thus the bar is appreciably deeper at its posterior edge. The object of the bar is to receive the first impact of weight and by acting as a lever to bridge the metatarsal heads and thus relieve the painful pressure points

Whilst conceding the beneficial results achieved by this device in many instances, practitioners have always been conscious of its anatomical and physiological imperfections Being a straight bar it takes the shortest route to pass between two points, viz the first and fifth metatarsal heads As the second, third and fourth metatarsals protrude appreciably beyond the first and fifth, the support to these areas is con-

necessary corrective twist to the foot. Thus the medial heel wedge inverts the heel and the lateral sole wedge everts the forefoot and depresses the first metatarsal The lateral wedge is also used in the treatment of varying degrees of talipes varus

A modified form of sole wedge is the toe wedge which is placed obliquely across the toe on the medial or lateral side. The medial toe wedge is used in children to correct in-toeing, and the lateral wedge out-toeing (Fig 82)



FIG. 82

Left to right—Medial toe wedge Lateral sole and medial heel wedge Lateral sole wedge

The fitting of all wedges should be done with the greatest possible care Patients should be seen at frequent intervals so that the practitioner can observe the reaction to this form of treatment Experience will show that a great variation in wedge thicknesses will be required in dealing with different cases In many instances in the treatment of pronated foot, the heel wedge may need to be appreciably thicker than the sole wedge, or vice versa The necessity of experimenting with wedges under the foot until the necessary corrective

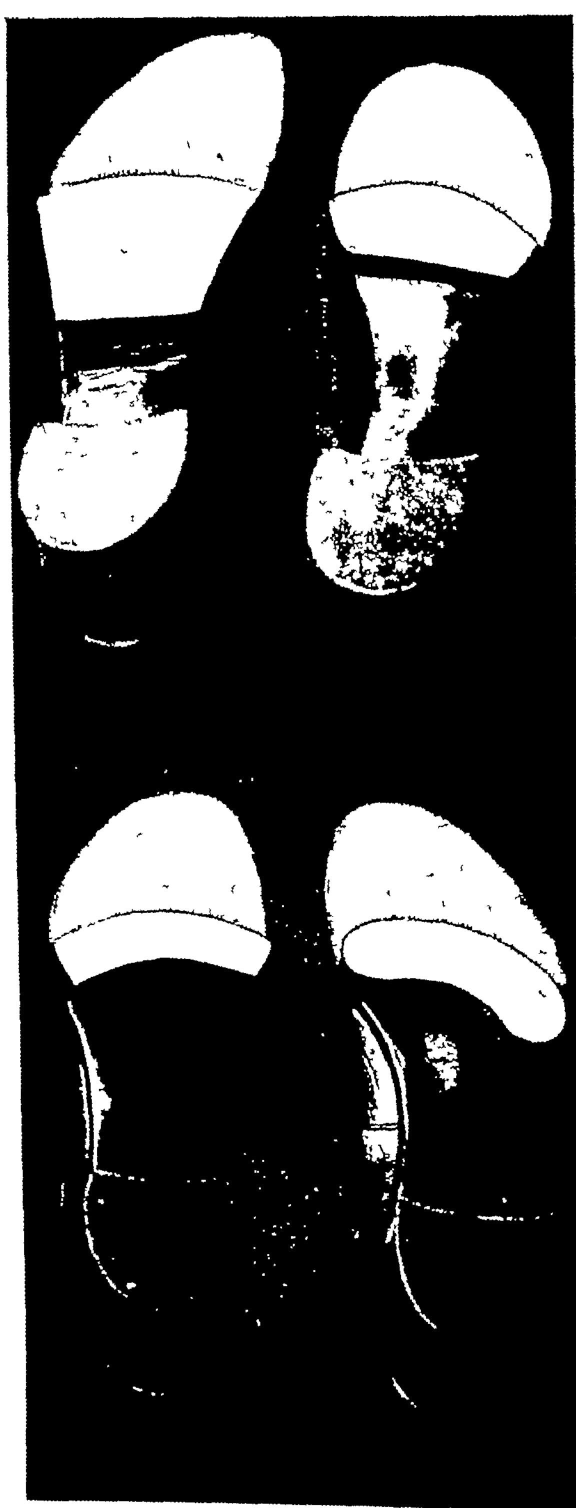


FIG 83

Top left—Anterior heel Top right—Mayo bar Bottom left—Crescent bar Bottom right—Kidney bar

siderably weakened. This is particularly so in the case of the second metatarsal. Many modifications have been introduced in an endeavour to eliminate some of its defects, and so improve the device whilst retaining its principles.

The Crescent Bar

In an endeavour to follow the curve of the metatarsal heads, a bar was introduced which curved forwards The depth and width of this bar is the same as that of the Thomas bar This form of bar, however, obviously tends to concentrate the lever action at the most forward point of the curve (Fig 83)

The Kidney Bar

This form of bar is strongly advocated by Brachman, who emphasises the flexibility of its application Stating that either the broad or narrow end can be placed at the medial or lateral side, according to the pathology of the case, he also points out that either end can be wedged for the same reason (Fig 83)

The Mayo Bar

Devised as a modification of the Thomas bar, the Mayo bar was first fitted in the clinic of the Mayo brothers The thickness of the bar at its anterior margin is the same as the Thomas bar It is, however, not straight, but follows the curve of the metatarsal heads The bar is about 1 in wide at the ends and 1½ in at its widest point The special features of this form of fitment is the curve of the forward edge and the wider surface area (Fig 83)

Anterior Heel

This form of metatarsal support is similar to the Mayo bar, but is considerably wider, extending back on to the waist of the shoe at least 1 in further than the Mayo bar The device is built up to maintain the surface at the same plane as the sole, to which it acts as an extension

A reinforcement of this kind is most useful on the lateral side of a shoe in the case of slight talipes varus, particularly if the shoe heel is buttressed. This is an excellent combination for weak ankles also.

Stiffening of the shoe upper on the medial side to support a valgus pad will frequently be found most effective The reinforcement is carried from the medial side of the heel down to the first metatarso-phalangeal joint The valgus pad, which is of surgical sponge, is secured in place by using rubber solution after the stiffening has dried out The soft covering leather is applied after the rubber pad has been secured in place

Balloon Patch

It is frequently found necessary to dispense with the patient's normal shoe during the treatment of an acutely inflamed bunion, even when the acute stage has been safely passed. The wearing of the ordinary shoe is often not possible, particularly as dressings have to be accommodated It is in such cases that the balloon patch will be found most useful, as in this way the additional room is provided

An old shoe more or less discarded by the patient is useful for this purpose An aperture is made in the shoe-upper over the joint, and a soft leather patch is solutioned in place over this The patch is fitted in such a way as to make it bulge out like a large blister Hence the alternative name of blister patch The aperture covered by the bulging patch provides a large pocket, into which the joint and covering dressing can fit At a later stage in the treatment the patch can be reduced, as the bulky dressings are found now to be no longer necessary Patches of this type are also most effective when applied over chronic corns occurring on the lesser toes

This work, in the opinion of the author, is a job for the shoemaker, who is skilled in his craft, and will carry it out neatly It is not advisable for the chiropodist to encroach upon this work, which requires much training and experience, being part of the craftsman's training

The Inserted Wedge Bar

One defect of the superimposed bar is the tendency to catch on a carpet, etc , causing the patient to stumble In an endeavour to overcome this difficulty and also that of rapid wear, some practitioners have inserted a piece of leather between the outer sole and middle sole to produce the same lever action as the metatarsal bar The shape of the thickening produced provides a distinct rocker action

Rocker Bar for Hallux Rigidus

This form of bar, unlike the metatarsal bar, is half round in section and of the same thickness all through It is dissimilar to the metatarsal bar in that it is placed across the metatarsal heads instead of behind them The bar is rounded to assist in producing a rocker action The mechanics of the device is to compensate for the lack of hinge movement in the first metatarso-phalangeal joint by a rocker action across it Experiments have also been carried out in the form of an insertion between the outer and middle sole as a modification of this device

Stiffening of the Uppers

It is frequently advantageous to strengthen or stiffen the uppers of a shoe, either to support weakened structures or to resist a mal-thrust The old method of achieving this was to strengthen the part with leather, but it is now possible to stiffen the upper of the shoe by using cellulose cement and suitable cotton bandage or crinoline

To obtain a satisfactory result, it is advisable to first clean the inside of the shoe, where the strengthening is to be applied, with a little of the cellulose solvent It may be necessary to thin down the cement with solvent to make it flow freely on the brush Apply a coat of the cement to the part to be strengthened, and then press on a strip of the fabric Repeat the process until three or four layers have been applied To finish the job neatly and leave a smooth surface, it is advisable to apply a final cover of soft leather, either a piece of basil split or glove kid will be suitable

waxed thread is prepared with a bristle at one end and a small tight knot at the other A hole is made in the upper, about ¼ in down and level with the breast of the heel, and the wax thread passed through until the knot is reached The wax thread is now laced round the top of the shoe, carrying it round the back of the heel until a position is reached level with the starting-point The thread is now pulled very tight and the upper slightly puckered or gathered in, after which the thread is secured with another knot and the surplus cut away The knots are now tapped flat It is surprising how much the heel fitting can be closed in by this method The lacing of the thread is done by making a series of holes and passing the bristles through them

A method of improving the ankle fit of laced shoes, which is worth noting, is to pad the tongue of the shoe with felt, as this is the equivalent to thickening out the instep A further method is to have two additional eyelet holes made, one at each side of the upper, just clear of the top eyelet holes in the shoe This method enables the very top of the shoe to be drawn in tighter when the shoe is laced

Stretching Shoes

It is often very helpful to be able to ease a shoe over a particular toe or across the vamp It is also at times quite useful to be able to raise the top of the toe-box, and thus relieve pressure on the toe-nail There are two main types of stretchers which are in common use

The General Purpose Shoe Stretcher

This is a machine possessing two forward arms, which come together or open at the instance of a worm screw, operated by a windlass These forward arms hold two metal fittings which are so shaped as to roughly resemble two halves of the fore part of a shoe There are usually three pairs of these fitments which are to be used for men's, women's and children's sizes respectively These metal shapes have a number of perforations situated on points where it is desirous to exert the

Widening the Vamp

Another surgical alteration that is often most useful is the widening of the shoe over the vamp That is the area between the first and fifth metatarso-phalangeal joints

In the case of a welted shoe it is usual to cut loose the welt at the side, skive the bottom margin of the upper and apply a patch with the object of providing more material with which to let out the upper When the patch has been secured in place, the welt is stitched to the new piece of leather and the sole secured to it Quite a considerable amount of additional room can be provided in this way

Cut-out for Calcaneal Exostosis

A very useful method of providing accommodation for a troublesome calcaneal exostosis is to cut the stitching round the top of the upper in the area of the heel When this has been done, the upper and lining are pressed down to expose as much of the stiffener as possible A U-shaped piece is now cut out of the back of the stiffener, large enough to accommodate the exostosis, after which the lining and upper are pulled back into the normal position and stitched By this alteration the hard stiffener is removed from the area over the exostosis or bursa, which is now so covered only by soft leather The pocket provided can be deepened by the use of the swan-neck stretcher

Improving the Ankle Fit

Various methods can be employed for improving the fit of the shoe round the ankle. One method is to obtain a piece of strong wash-leather, of appropriate size, and skive it thin round the margin The leather is now folded over at the top to a depth of about half an inch and secured with solution The wash-leather is now placed in the shoe with the folded portion fitting level with the top of the shoe, being secured with solution, and stitched round the top. Another method is to stitch a roll of velvet round the top of the shoe One of the best methods, however, is again the work of the craftsman A

SHORTAGES

A true shortage of a limb which can be measured from the pelvis to the medial malleolus is designated a *Structural Shortage* Such a shortage remains fixed both on weight-bearing and at rest

A shortage due to the contraction of muscles controlling a limb is really a pseudo-shortage In a shortage of this kind, which is termed a *Postural Shortage*, the measurements from

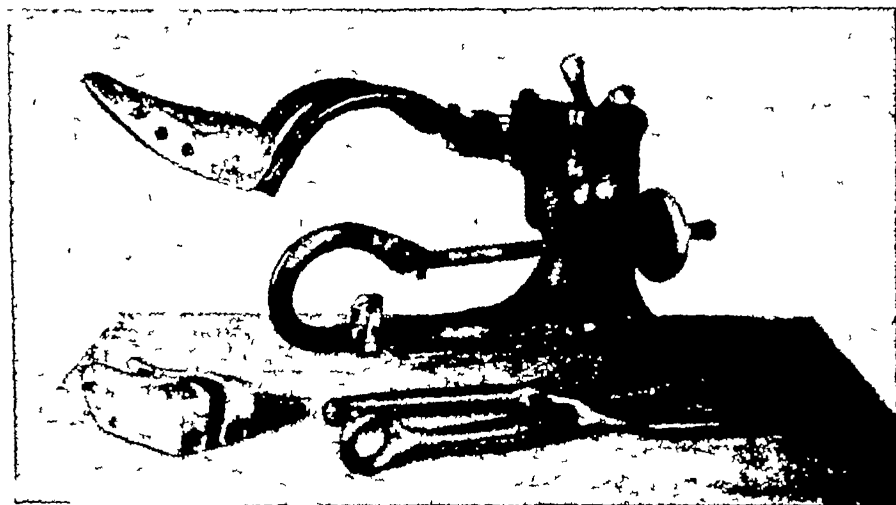


FIG 84

Device in the background is the largest standard type of stretcher the swan-neck type stretcher is in the foreground

the pelvis to the medial malleolus are the same in both limbs, but measurements from the umbilicus to the medial malleolus show the variation in length if the muscle spasm is retained whilst the patient is in a recumbent position Shortages are met with which are both structural and postural, but in such cases the apparent shortage on weight-bearing will be found to be greater than the shortage measured at rest Whilst it is not possible to correct structural shortages by mechanical means, such shortages can be accommodated

greatest stretching strain, namely over the first and fifth metatarso-phalangeal joints, and situations equivalent to the dorsal aspects of the lesser toe joints, into which metal studs are fitted Another fitment is designed to hook into the heel of the shoe, and is attached to another wheel operating a screw shaft To stretch the shoe, the metal studs are placed in the metal shapes at the desired points The shoe is now placed on the stretcher and the heel piece hooked in position The wheel operating this portion is turned, drawing the hook back until it is tight in the heel, and holds the shoe on the fore part stretcher The windlass which operates the fore part of the stretcher is now turned, separating the forward arms and causing a transverse stretching to be brought to bear on the vamp of the shoe, the greatest strain being exerted on the portion where the studs are situated

It is not advisable to exert too much pressure on the leather at once, but to apply the stretching strain gradually, applying a few turns for a while and then applying another turn or two It is far more satisfactory to leave the shoe on the stretcher for a few days after the final stretching pressure has been exerted, as this will ensure that the stretching is maintained

Swan-neck Stretcher

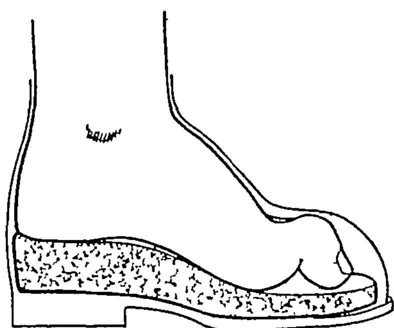
This is a simple form of stretcher which is designed not unlike a pair of coal tongs The two portions are "S" shaped and are joined by a screw The device is formed into hand-grips, whilst at the other, one portion is formed into a ring, and the other a ball When the hand-grips are closed, the ball fits into the ring

To use this stretcher, the ball-shaped end is placed inside the shoe at the point to be stretched As the hand-grips are squeezed, the leather is pressed by the ball into the ring, stretching it into a bulge or blister This machine is for very local application, and requires a great deal of exertion on the part of the operator to produce substantial permanent stretching A good plan is to exert the necessary pressure and then tie the handles with string, so that the shoe can be left with the stretcher in it for a reasonable length of time (Fig 84)

diffusion of pressure is ensured, and the comfort of the appliance is achieved by its cushioned surface These combined elevation appliances have proved consistently successful in many cases of severe talipes equinus

Slight shortages, say of $\frac{1}{4}$ in or a little more, can be disregarded as they can be accommodated by the body without difficulty, irrespective of the type of shortage

In making an accommodation appliance for a structural shortage, such as a cork elevation for the shoe, Brachman suggests that for a shortage of less than $1\frac{1}{2}$ in it is only necessary to elevate the mid-tarsal area, the additional weight thrust being taken by the ball of the foot, but if the fixed shortage is greater than this it is necessary to extend the elevation beneath the ball of the foot to achieve an even distribution of weight-bearing through the foot



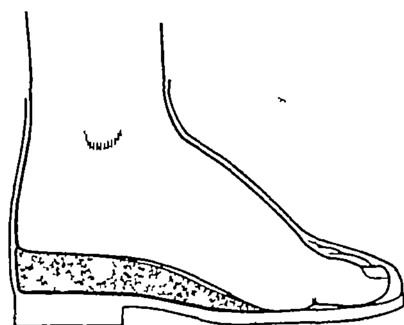


FIG 85
Examples of cork elevations

Cork Elevations

Cork elevations of a moderate nature, 1 to 2 in, can be fitted to stock shoes if a collar is fitted to the shoe uppers

In the more severe shortages, however, it is usually necessary to fit a cork sole and heel extension (Fig 85)

In many cases requiring surgical boots with cork elevations it is not always possible to achieve a perfect distribution of weight-bearing, and as a result painful pressure areas result In such cases painful calluses and even trophic ulcers result from the friction and pressure

It is in such cases that the author's technique of grafting the plastic surgical insoles to the cork elevations has proved so beneficial, particularly if the cushioned surfaced type of insole is used The success of this form of appliance is due to the absolute accuracy with which the surface of the appliance fits the plantar surface of the foot In this way complete

factor to the formation of the painful callosities on the ball of the foot

ASSESSMENT —My conclusion, as the result of this investigation, was that an indifferently fitting cork elevation whilst giving the correct degree of lift had failed to provide stability for the foot Instead of fitting truly to the contour of the plantar surface, thus holding it securely and diffusing pressure, it merely provided a sloping platform down which the foot was precipitated This forward progress being arrested by the end of the shoe resulted in the symptoms previously described It was therefore decided to make a double-flange surgical insole on a cast of the foot, the metatarsal area being provided with a cushioned surface This cupped heel, double-flange appliance was grafted on to the cork elevation, and resulted in the patient being provided with a fitment in his surgical boot, which embraced accurately the whole plantar surface of his foot The cupped heel and the medial and lateral flanges contributed a bracing effect, whilst the cushioned anterior surface supported the metatarsal region The absolute accuracy of the fit of this appliance resulted in complete diffusion of pressure and secured and stabilised the foot in the proper position in relation to the boot Previous to the fitting of this appliance, the patient had suffered considerable pain and was receiving chiropodial treatment fortnightly, but had experienced very little relief

In the first twelve months following the fitting of the appliance, treatment had only been necessary on four occasions During these visits, it was noted that the patient had experienced only a little discomfort rather than that of actual pain, and the callosity was considerably reduced During the second year a replacement appliance was fitted, and further chiropodial treatment has not been found necessary (Figs 86, 87, 88)

Male Aged 30 Years

HISTORY —This patient who had a history of anterior poliomyelitis as a child was referred to me by a foot hospital

EXAMINATION —There appeared to be a long history of severe metatarsal pain for which regular chiropodial treatment

CHAPTER XII

A SELECTION OF INTERESTING CASES

THIS chapter was compiled with the object of providing a small selection of cases (each different in character) in which the author has employed in his treatment, in some form or other, one of the appliances described in this book

The assessment in each case has been carefully recorded to enable the reader to follow the author's reasoning in arriving at his conclusion, as to the type of appliances to be used, in approaching the solution of each individual problem

It is also desired to convey by this chapter some idea of the scope and immense possibilities of this field of work

Male Aged 58 Years

HISTORY —This patient with a history of anterior polio-myelitis as a child was referred to me by an orthopædic surgeon As a result of this disease and subsequent wasting of the limbs, the condition terminated in a typical talipes equinus with considerable shortening

EXAMINATION —The examination revealed painful callosities around the margin of the heel, ball of the foot and the dorsal aspect of the great toe Careful checking of the patient's surgical boot and cork elevation showed that the latter was a very indifferent fit in relation to the contour of the plantar aspect of the foot There was a distinct space between the surface of the cork and the long arch On weight-bearing, excessive weight was borne by the heel and the ball of the foot The foot tended to be precipitated forward into the toe of the shoe, resulting in a back pressure on the great toe, producing a severe hallux flexus Dorsal pressure on the toe caused the formation of a chronic corn and underlying bursa The back pressure on the ends of the toes aggravated the subluxation of the metatarso-phalangeal joints, and was a contributory

had given a measure of relief The patient had been referred because it was felt that possibly relief of a more positive and permanent character could be achieved by the fitting of appropriate appliances The left foot showed a condition of severe pronation, with subluxation of the metatarso-phalangeal joints of the lesser toes and valgus deviation of the great toe It was obvious that the condition of the left foot was due to taking the greater degree of active and passive strain As the



FIG 88

The foot in position on the appliance

result of the disease previously referred to, the right foot showed a condition of talipes equino varus, with clawing of the toes and hallux flexus, which had in turn produced painful corns

ASSESSMENT —In dealing with this case, two distinct types of appliances were necessary In the case of the left foot, a corrective insole for pronated foot was fitted, with a sponge surface anterior metatarsal support For the right foot, it was decided to make a cushioned surface insole with a lateral buttress and the necessary anterior metatarsal support. It



FIG 86

Talipes equinus Poorly fitted cork elevation showing space between the instep and the cork



FIG 87

The appliance and the patient's foot

FIG 90

Surgical shoes and appliances Note elevation incorporated in the appliance for the right foot



FIG 91

Patient wearing appliances and the surgical shoes

also incorporated a cork elevation appropriate to the shortening of the limb It is obvious that appliances of this nature require surgical shoes to accommodate them The necessary shoes were made, and in the case of the right foot the heel was designed with a lateral buttress. Once again the combination of appliances and surgical shoes proved highly successful, the



FIG 89
Clinical picture of feet showing talipes equino varus (right) and pes planus and retracted toes (left)

patient saying he had never walked with so much comfort before (Figs 89, 90, 91)

Male Aged 55 Years

HISTORY —This patient was referred by his doctor on the advice of an orthopædic surgeon He was a very severe case of kyphosis

EXAMINATION —The examination of the patient's feet showed a severe condition of talipes varus, more marked in the left foot The strain on the lateral malleoli resulted



FIG 92

Talipes varus Note the supination and inversion of the left foot The burst welt can be clearly seen on the lateral side

in large ganglionic swellings The cuboid bones were very large and prominent, being subjected to severe pressure and friction, resulting in the formation of large and painful callosities In the case of the left foot, the lateral thrust was so great as to burst the welt away from the shoe The patient was quite unable to gain any degree of stability, and locomotion was erratic and staggering

The treatment of this patient was rendered more difficult owing to his hypersensitivity to his condition, as an example of this, he was adamant in his objection to the wearing of surgical boots

ASSESSMENT —The object in this case was to achieve the best degree of stability possible by countering the lateral thrust and relieving as much as possible the strain on the lateral malleoli Casts of the feet were made and surgical insoles designed, each with a strong lateral buttress Special accommodation and soft padding had to be provided for the cuboid bones The stabilising effect of the appliance was further improved by a deep cupping of the heel A pair of new shoes, of the type previously worn by the patient, were fitted with lateral buttress heels The heels were extended on the lateral side to fill in the whole of the waist of the shoes, and the buttressing was designed with a very marked flare

The combination of the insoles and the alteration to the shoes produced a marked improvement in the stability of the patient A diffusion of pressure was achieved by the accurate fit of the appliances This was particularly applicable to the cuboids, where the perfect cushioning provided complete protection The strong lateral flange received the initial thrust, and assisted in relieving the strain on the malleoli

In this case the beneficial effect of the appliances could not be achieved without the important shoe modifications The lateral buttressing and extending of the heels succeeded in stabilising the appliances in the shoes, which produced a combination resulting in a marked corrective effect on the feet When wearing the shoes and the appliances the patient was able to stand and walk without the assistance of sticks (Figs. 92, 93, 94, 95)



FIG 95

The same patient with appliances and shoes fitted with surgical alterations

Female Aged 65 Years

HISTORY —This patient who was suffering from arthritic flat foot was referred to me by an orthopædic surgeon



FIG 93
Stabilising appliances, showing depression to accommodate the cuboid bones



FIG 94
Surgical alterations to shoes, showing lateral extension and buttress

EXAMINATION —The patient was complaining of severe pain when walking The condition had reached the distressing stage when locomotion had become a misery to the patient, and showed every prospect of reducing the patient's mobility



FIG 95

The same patient with appliances and shoes fitted with surgical alterations

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FIG 93
Stabilising appliances, showing depression to accommodate the cuboid bones



FIG 94
Surgical alterations to shoes, showing lateral extension and buttress

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FIG 96

Arthritic flat foot Note amputation of middle three toes, left foot Keller's operation, right foot



FIG 97

Shoes and appliances Note the broad-waisted shoes and rigid rest appliances

to the absolute minimum A Keller's operation had been performed on the first metatarso-phalangeal joint of the right foot for hallux rigidus The middle three toes of the left foot had been amputated because of gross deformity, there was also a severe valgus deformity of the great toe. With regard to the long arch, whilst there was some flattening of the feet, the condition was mainly one of pronation. Arthritic changes had resulted in an absence of movement in the tarsal and sub-taloid joints

ASSESSMENT —In cases of this nature the pain arises as the result of stress upon the joints seriously affected by advanced arthritic changes In such cases it has been found that a rigid appliance as distinct from a semi-rigid arch support is advisable It was decided in this case to make rest appliances of a rigid type, with a cushioned surface Inside flanges were provided which were continued down in the form of buttress walls to receive the medial thrust Again, the principle of diffusion of pressure was introduced, the insoles being made on casts of the patient's feet, the pressure was evenly distributed over the supporting surfaces by the perfect relationship of the contours of the superior surface of the appliances and the plantar surface of the patient's feet The squaring off of the medial flange assisted in stabilising the appliances in the shoes, and countering the tendency to tilt over under pressure of the feet when weight-bearing The layer of surgical sponge on the surface of the appliances provided an initial cushioning and shock-absorbing effect In cases of severe pronation of this nature, the appliances are essentially broad and cannot be satisfactorily fitted in ordinary stock shoes Therefore, in this case, surgical shoes were made with the broad waists necessary to accommodate and stabilise the appliances properly The shoes were also fitted with floated heels to assist still further in establishing the complete stability of the feet This combination of insoles and surgical shoes proved to be a distinct success All the points aimed at in the assessment were achieved, i e elimination from pain, relief from strain of the joints and complete stability of the feet (Figs 96, 97, 98)

FIG 96

Arthritic flat foot   Note amputation of middle three toes, left foot   Keller's operation, right foot



FIG 97

Shoes and appliances   Note the broad-waisted shoes and rigid rest appliances

Female Aged 26 Years (Lobster Claw Feet)

HISTORY —This congenital deformity was inherited from her father and passed on to her male child The patient attended Salford Royal Hospital, where she was fitted with bespoke shoes to accommodate the unusually shaped feet



FIG 98

The patient was successfully stabilised by combination of the shoes and appliances

The case was referred to me at Hope Hospital with a view to stabilising the feet

EXAMINATION —Examination of the feet revealed that in the case of the left foot there was a marked degree of pronation due to an elevation of the first metatarsal. There was a valgus displacement and elevation of the great toe In the case of the right foot, the elevation of the first metatarsal was very marked, but a hyperflexion of the great toe compensated for this and stabilised the medial arch Excessive friction and

pressure, however, beneath the inter-phalangeal joint of the great toe had resulted in a painful callosity A severe lateral thrust on the fifth metatarso-phalangeal joint and along the plantar surface of the fifth toe had also resulted in painful callous formation

ASSESSMENT —On the basis of the examination of the case I decided to provide a rest appliance for the left foot which would support the foot against the tendency to pronate A build-up of cork on the appliance beneath the first metatarsal was incorporated to take up the space between the elevated first metatarsal and the floor of the shoe A firm inner flange also assisted in the stabilisation of the foot, and in combination with the cork build-up prevented pronation The appliances which were made upon a cast of the plantar surface of the foot was cushioned with surgical rubber sponge By this combination of the medial build-up and diffusion of pressure the foot was stabilised In the case of the right foot, two factors had to be considered, one was the painful pressure area on the inter-phalangeal joint of the great toe due to hallux flexus, and the extreme friction and pressure beneath the fifth metatarso-phalangeal joint due to the severe lateral thrust In this case the appliance was made with the object of complete diffusion of pressure Cork build-up was carried along the medial side to the base of the inter-phalangeal joint to take the weight off this painful area The appliance was flanged and buttressed on the lateral side to receive the thrust and relieve the strain on the fifth metatarso-phalangeal joint A latex and sponge rubber shield encased in wash-leather—on the toe glove principle—was made to fit on the fifth toe and metatarso-phalangeal joint The padding was situated along the plantar surface to provide a cushioning effect The appliances fitted in the bespoke shoes perfectly, and when wearing the appliances in the shoes the patient was not only perfectly comfortable but an extremely satisfactory psychological effect was achieved of added confidence in herself She not only felt stable and walked with greater confidence but the posture and gait were distinctly improved It is hoped by the experience gained in treating the mother that satisfactory treatment of the child can be undertaken

It would be unwise, however, to assume a successful conclusion of this case on the basis of the initial success (Figs 99, 100, 101, 102, 103)

Woman Aged 45 Years

History —This patient who was suffering from a long-



FIG 99

Lobster claw feet Showing identical duplication of the mother's feet in the male child

standing condition of arthritis was referred to me by a chiropodist

Examination —The patient complained of extreme pain on the ball of the foot and the ends of the toes, with intermittent pains in the feet generally. Gross deformity of the toes had occurred, resulting in the formation of painful distal corns The second toe on the left foot and the second and third on the right had been amputated There was a severe hallux valgus deformity of the left foot and some degree of hallux flexus on the right A subluxation and arthritic changes

FIG 100

Casts and appliances Note the contours of the superior surface of the appliances



FIG 101

Note the perfect fit of the appliances to the casts



FIG 102
Appliance fitted in the left shoe



FIG 103

Patient wearing the surgical shoes and appliances Note the fringed tongue style to hide the peculiar shape of the feet

in the metatarso-phalangeal joints had resulted in painful callosities The patient had been receiving chiropodial treatment which had proved the only means of obtaining any measure of relief, but had reached the stage when the repeated application of pads and plaster had induced a deleterious action on the skin in the form of a severe plaster dermatitis over the metatarsal area

ASSESSMENT —It was decided that a straightforward moccasin appliance was the best means of dealing with this condition A combined valgus pad and metatarsal support in surgical sponge was built on to the appliance The metatarsal pad was extended as a bevel over the metatarso-phalangeal joints A sponge rubber overlay was applied over the whole plantar area, and extending over the ends of the toes These simple and uncomplicated mocassins proved completely effective No further symptoms were experienced by the patient After five months' wear a review of the case was carried out The result was astonishing, not only was there a complete absence of any dermatitis, but the callosities had also disappeared The dry keratotic condition of the skin previously noted had given place to the soft and silky tissue of a young and healthy foot The second pair of appliances have been recently fitted, and the patient is quite happy, experiencing no symptoms (Figs 104, 105, 106)

Girl Aged 14 Years

HISTORY —This patient who was a post-operative accident case was referred to me by an orthopædic surgeon

EXAMINATION —The patient complained of extreme pain over the suture areas and certain pressure points on the anterior plantar margin of the foot Owing to the absence of sufficient subcutaneous tissue, there was insufficient natural cushioning of bony prominences As the result of the severity of the accident, there was considerable scar tissue in the region of the malleolus There was a deep cleft situated in the centre of the plantar surface of the foot anteriorly, resulting in pressure being thrown on to the anterior margin The general circulation in the foot was extremely poor.

FIG 104

Deformity of lesser toes and plaster dermatitis on the plantar surface of the feet can clearly be seen



FIG 105

Plaster casts of the feet and the moccasin appliances

in the metatarso-phalangeal joints had resulted in painful callosities The patient had been receiving chiropodial treatment which had proved the only means of obtaining any measure of relief, but had reached the stage when the repeated application of pads and plaster had induced a deleterious action on the skin in the form of a severe plaster dermatitis over the metatarsal area

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aperture The buffer was so designed to receive the pressure on the upper and lower margin, allowing the suture areas to rest in space. Plantar padding was still further improved by supporting the two anterior pressure areas.

The appliance proved perfectly successful, the foot was reasonably stabilised and there was a complete absence of symptoms. It is six years since the first successful appliance was fitted Three replacements of a similar type have been provided.

There is some improvement in the circulation, the scarred appearance of the tissues around the malleolus has greatly diminished, whereas on the first appearance the ankle was puckered and shrunken, it is now filled out to normal proportions, and in thin silk stockings compares favourably to that of the other (Figs 107, 108, 109)

Male Aged 78 Years

History —This patient was referred from an old people's institution by the consultant chiropodist The case was a gross talipes equinus deformity with a slight varus deviation

Examination.—The patient complained of painful callosities on the ball of the foot The callosity was very considerable and complicated by a corn with a deep-seated nucleus situated over the head of the fifth metatarsal

The extreme angulation of the foot resulted in the subluxation of the metatarso-phalangeal joints, causing a direct thrust on the metatarsal heads

The patient was wearing an old felt boot, many sizes too big The severe pain considerably restricted the patient's mobility

Assessment —It was obvious that the object of any appliance in this case would be to provide a satisfactory means whereby the thrust on the heads of the metatarsals could be received and cushioned

A cast of the foot was taken and considerable experiment was carried out The resultant appliance was a corset-like device which embraced the tarsus The plantar portion was carried forward to the base of the toes, and heavily padded

ASSESSMENT —A moccasin appliance was decided upon to provide a soft and resilient support and a measure of insulation On the plantar surface, padding was introduced into the cleft to ensure pressure diffusion, valgus padding to give support to the medial arch was also introduced In making the first appliance, plantar padding of latex foam was carried forward over the anterior margin on to the dorsal surface, and further



FIG 106

Patient wearing the moccasin appliances

padding over the anterior margin was provided with the object of building up a very soft and resilient buffer The appliance had a lining of fine chamois leather This appliance was, however, not successful, so exceptionally sensitive were the suture areas that even the fine, soft chamois leather and soft, resilient sponge could not be tolerated After giving considerable thought to the problem, a new moccasin was made in which anterior padding was provided by a buffer with an

aperture The buffer was so designed to receive the pressure on the upper and lower margin, allowing the suture areas to rest in space. Plantar padding was still further improved by supporting the two anterior pressure areas

The appliance proved perfectly successful, the foot was reasonably stabilised and there was a complete absence of symptoms It is six years since the first successful appliance was fitted Three replacements of a similar type have been provided

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Male Aged 78 Years

HISTORY —This patient was referred from an old people's institution by the consultant chiropodist The case was a gross talipes equinus deformity with a slight varus deviation

EXAMINATION —The patient complained of painful callosities on the ball of the foot The callosity was very considerable and complicated by a corn with a deep-seated nucleus situated over the head of the fifth metatarsal

The extreme angulation of the foot resulted in the subluxation of the metatarso-phalangeal joints, causing a direct thrust on the metatarsal heads

The patient was wearing an old felt boot, many sizes too big The severe pain considerably restricted the patient's mobility

ASSESSMENT —It was obvious that the object of any appliance in this case would be to provide a satisfactory means whereby the thrust on the heads of the metatarsals could be received and cushioned

A cast of the foot was taken and considerable experiment was carried out The resultant appliance was a corset-like device which embraced the tarsus The plantar portion was carried forward to the base of the toes, and heavily padded

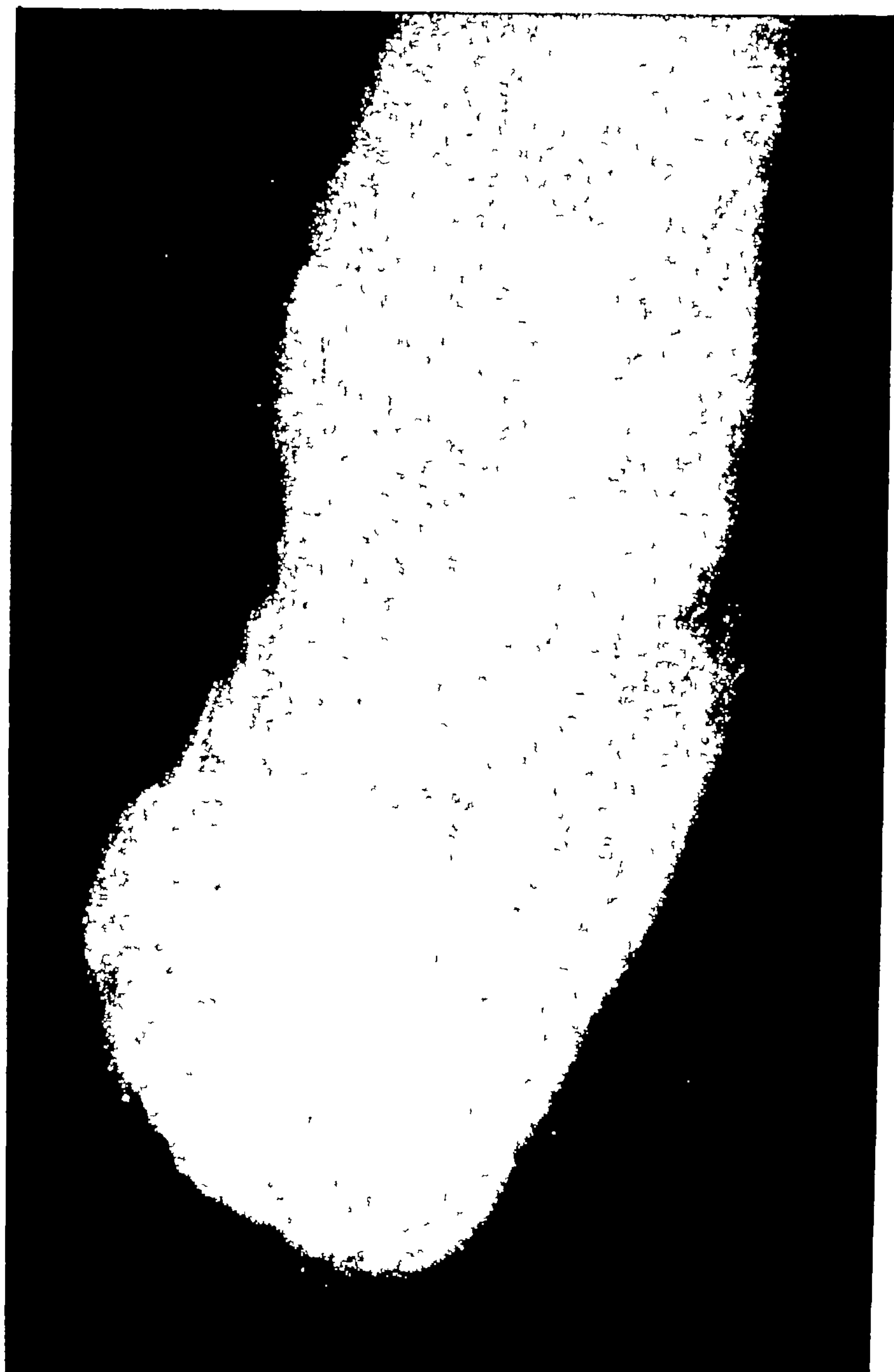


FIG 107

Post-operative accident case Girl aged 14 years Suture areas can be plainly seen

with surgical sponge and appropriately moulded with suitable depressions The margin of the anterior plantar portion was formed into a cushioned roll, which, fitting as it did into the



FIG 108
Same case showing deep cleft on plantar area

crook of the toes, provided a supporting prop The appliance was lined with chamois leather, which was also carried forward over the anterior roll The tarsal portion was divided down the front and fitted with eyelet holes and a lace When laced in position, the appliance fitted securely and snugly to the

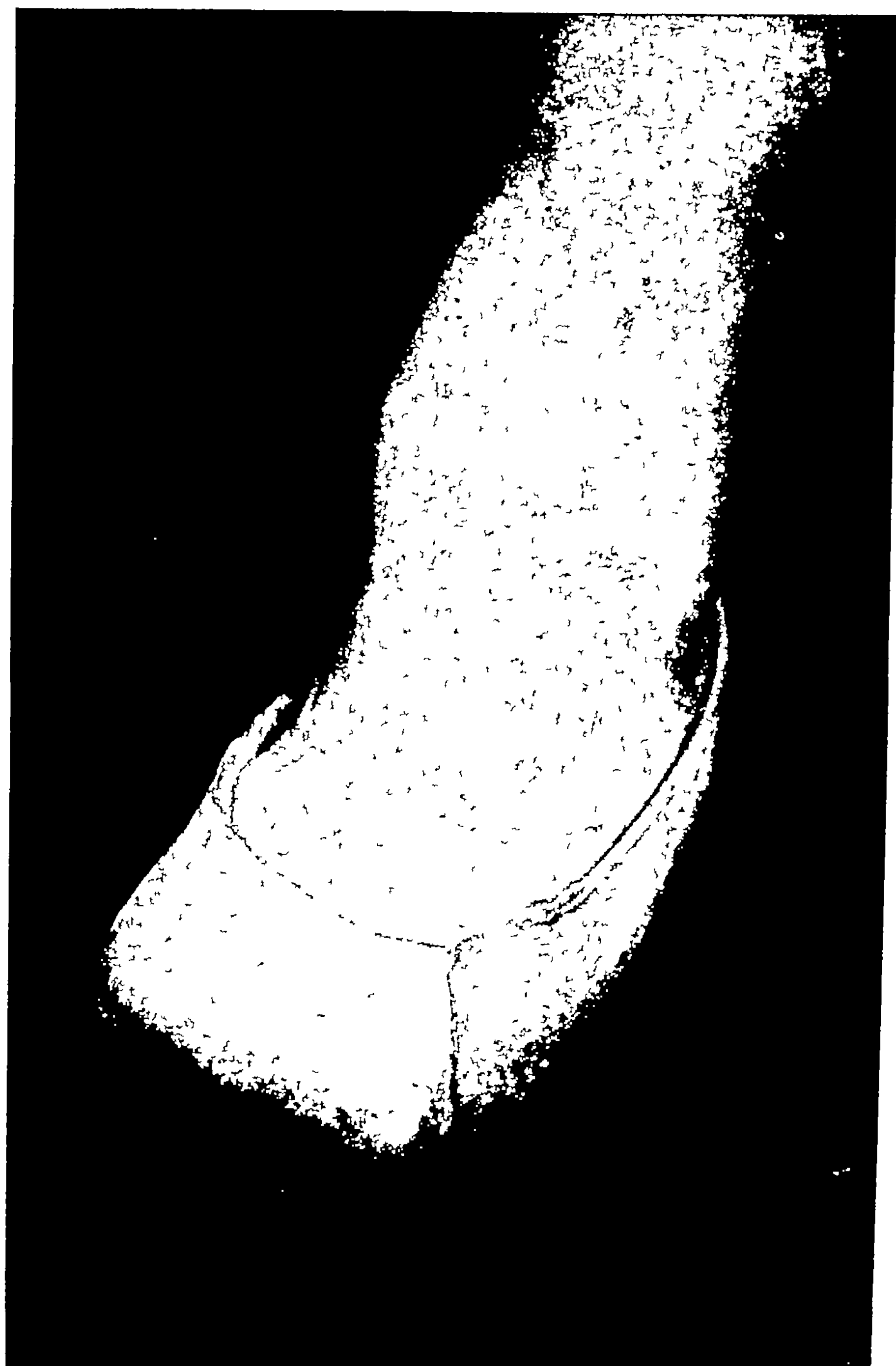


FIG 109

Moccasin appliance fitted on the foot

foot, the toes protruding from an aperture formed between the anterior roll and the dorsal portion

A suitable boot was designed to accommodate the foot and the appliance The result was most gratifying, a complete



FIG 110

Extreme talipes equinus with slight varus deviation Patient aged 78

absence of the symptoms was reported by the patient, who is now completely mobile, and has been free from pain over a considerable period of time This result has been maintained, and there is every indication that the success of this solution of the problem is permanent (Figs 110, 111, 112)

Girl Aged 14 Years

HISTORY —This was a case of spina bifida, referred from the orthopædic department of a general hospital Ulceration had resulted in erosion of all toes, except the fourth right foot



FIG 111
Cast and finished appliance

EXAMINATION —At the time the patient was examined there was a perforating ulcer beneath the first metatarsal head, with the sinus radiating posteriorly The object in referring the case was to produce an appliance which would cushion and

protect the affected area, and thus assist healing There appeared to be no breaking down of the tissue elsewhere

ASSESSMENT —In treating this condition a moccasin appliance was decided upon as being the best means of providing pro-

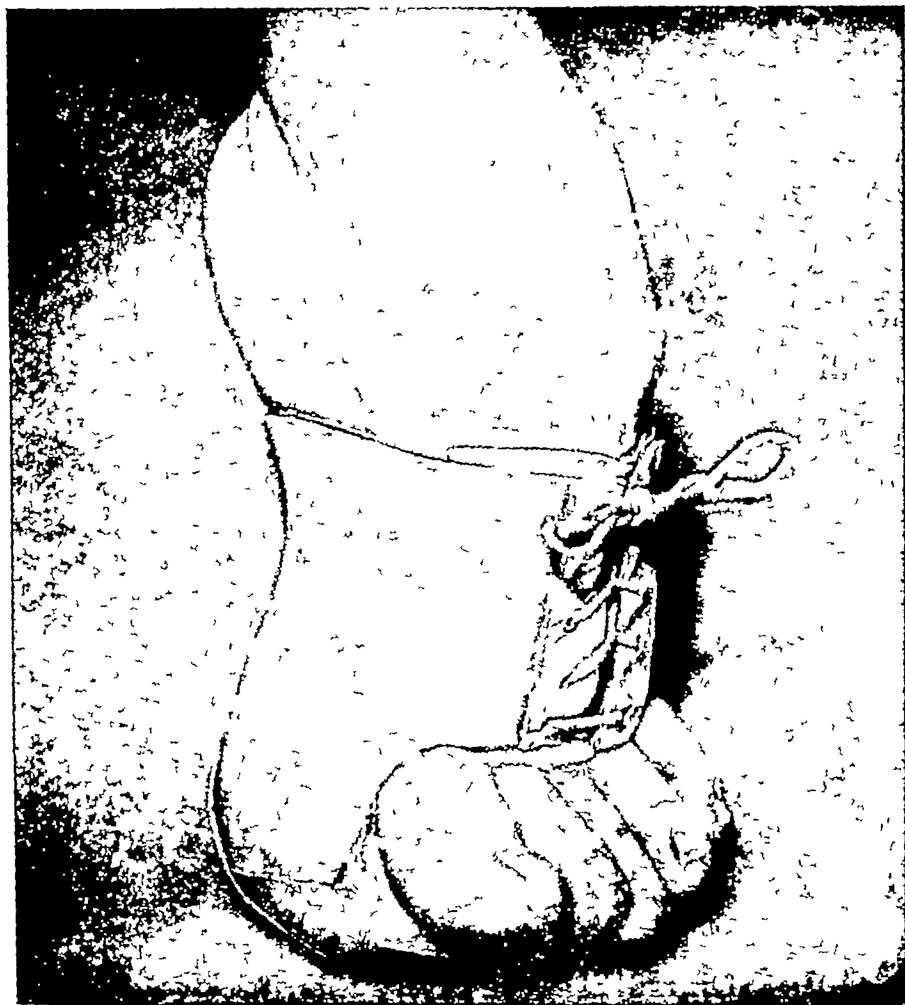


FIG 112
The appliance fitted on the patient's foot

tective padding which could not be dislodged or displaced when the patient was walking It was also felt that this type of appliance was easily removed and replaced during treatments of the ulceration The device was designed with a valgus pad extending to the metatarsus and a soft cushioning

portion with a marked depression over the opening of the sinus The surgical sponge was so shaped and formed as to receive the weight on the valgus pad, and the outer portion of the metatarsal extension The overriding pressure on the area of the ulcer was taken by the additional soft cushioning, and the depression over the sinus provided protection from any pressure

This appliance proved successful in providing the necessary protection of the affected area, preventing irritation and the breaking down of the tissues at other weight-bearing points It also considerably assisted the frequent change of dressings In several similar cases, ulceration of long standing has promptly responded to the fitting of these appliances by rapid healing where previously the tissues had invariably broken down and ulcerated when the foot had become weight-bearing The continued wearing of these appliances in such cases has maintained healing

It is felt that one of the most important functions of an appliance in cases of this nature is to provide protection and prevent the breaking down of the tissues as a result of friction and pressure (Figs 113, 114, 115)

Female Aged 17½ Years

HISTORY —This case of congenital absence of toes was referred to me by another chiropodist

EXAMINATION —On examination it was noted that in the case of the left foot the tarsus was normal, in the right foot the cuneiforms had not properly developed As a consequence, the anterior portion of the right tarsus was narrower than that of the left The medial arch was very distinct, with a deep cleft extending along the tarsus, causing an acute concavity The prominence of the heads of the first and fifth metatarsals resulted in painful plantar callosities, which extended on to the anterior margin The flexibility present in the normal foot was absent, causing the patient to be unstable on weight-bearing It is interesting to note that in the case of the left hand of this patient there was a congenital absence of the fingers Not only had the patient a considerable degree of

discomfort and a measure of instability, the footwear also constituted a serious problem Another aspect of this case was the psychological effect of these deformities on the patient, who had become markedly conscious of being an oddity



FIG 113

Perforating ulcer with sinus radiating back over the metatarsus

ASSESSMENT —In approaching this case I felt that I had three problems to solve, firstly, to provide relief from pain, secondly, to establish stability, and thirdly, to provide an appearance of normality Casts were taken and experiments were carried out in designing a suitable moccasin appliance.



FIG 114

Cast and moccasin

FIG 115

Patient wearing the moccasin appliance

The moccasin was so designed as to provide support for the medial arch and to relieve pressure from the two anterior pressure points This was achieved by fitting sponge rubber valgus pads with lateral extension, passing forward into the deep groove in the anterior portion, in fact the whole of this depression was completely filled in A sole piece of thin sponge was now fitted over the whole plantar surface and carried forward over the anterior margin of the appliance

The next step was to build up and shape the false forefoot, before doing this, however, I felt it advisable to fill in the hollow on the lateral side of the tarsus on the right foot so that its contour matched the left The reason for this was to ensure that the finished appliances were the same size and properly matched, and so would fit correctly in a normal pair of shoes

A false forefoot was shaped and built up from segments of surgical sponge When worn with stockings, these appliances gave the appearance of perfectly normal feet Stability was achieved, firstly, by the sponge valgus support and, secondly, by the false forefoot The false forefoot played an important part in establishing stability by reconstructing the equivalent of the hinge action of the metatarso-phalangeal joints, and by the degree of the resistance offered when the foot was bent in walking, inducing a similar action as that which occurs when the toes press against the sole of the shoe, an important stabilising factor often overlooked

These appliances were exceptionally effective, all symptoms disappeared and stability was established The stockinged foot presented a normal appearance and the patient was able to fit and wear ordinary shoes These not only looked normal in wear but retained their shape in use, owing to the resilient forward extension filling and padding out the front of the shoe The patient has now been wearing these moccasins for a considerable time, an endeavour has been made to improve her last pair further by making a liberal number of perforations all over the uppers of the appliances to assist aeration, and reports on this innovation are awaited (Figs 116, 117, 118, 119)

Girl Aged 5

HISTORY —This patient was referred to me from another hospital This girl had only the fifth metatarsal and toe on each foot, the cuneiforms were undeveloped, but the other tarsal bones were normal There was complete absence of toes and metatarsus, with the exception of the fifth metatarsal



FIG 116

Congenital absence of toes Girl aged 17½ years

and fifth toe It is interesting to note that the child's father had similar deformities The patient's hands are similarly malformed, only a portion of the hand and the little finger being present

EXAMINATION —The fifth metatarsals and toes were set at an abnormally oblique angle to the rest of the foot Absence of the metatarsus and most of the tarsus on both feet resulted in

the feet falling over on to the navicular in weight-bearing, which is equivalent to pronation in the normal foot. In the case of the left foot there appeared to be an abnormal thrust

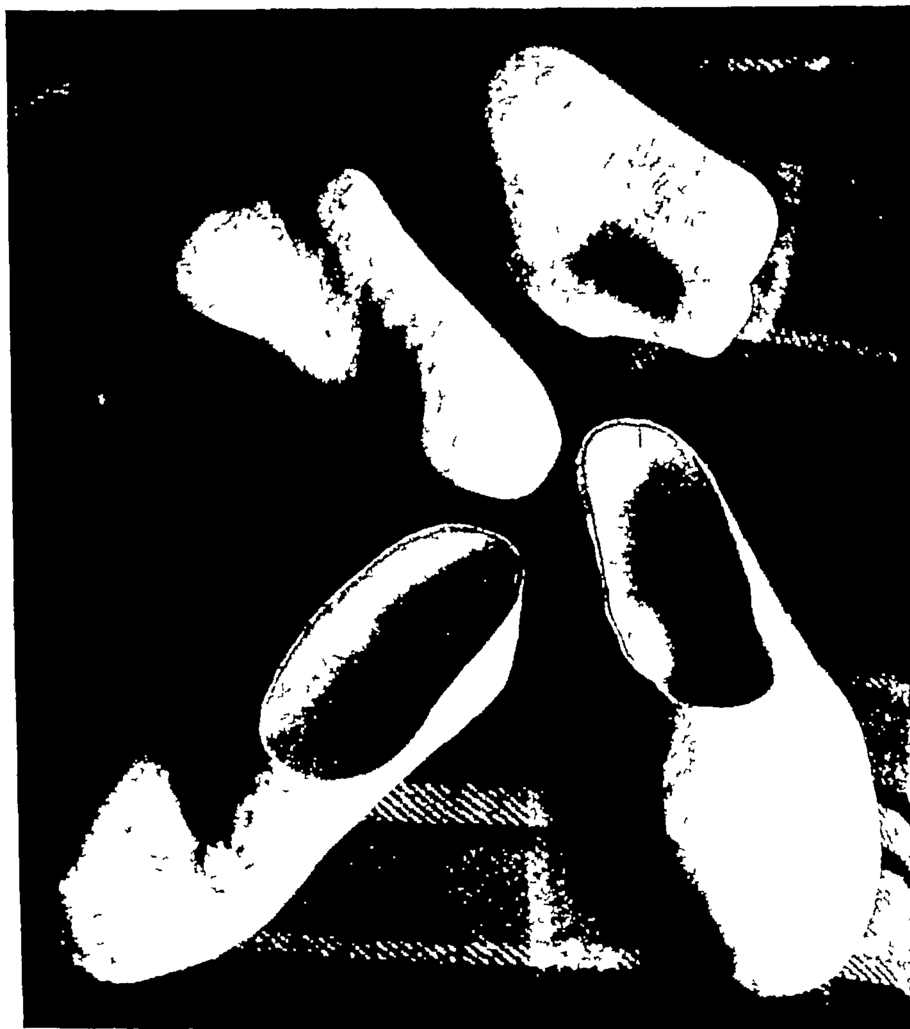


FIG. 117
Casts and finished moccasins

on the fifth metatarso-phalangeal joint, the condition being characterised by the presence of a callosity. On the right foot there were signs of abnormal pressure and friction on the anterior aspect. It would appear that slight bony prominences were inducing the formation of bursae and callosities. It should

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EXAMINATION —The fifth metatarsals and toes were set at an abnormally oblique angle to the rest of the foot Absence of the metatarsus and most of the tarsus on both feet resulted in

be noted that whilst the plantar surface of the left foot was more or less concave, that of the right foot was convex

ASSESSMENT —It was decided to make a pair of moccasin appliances with a sleeve for the fifth toe As the fifth toe of the right foot tended to elevate, it was decided that the sleeve should be braced on the plantar surface with the object of pulling the toe down An operation to fix the toes at a more



FIG 120

Congenital absence of toes, showing the feet weight bearing Note the angle of the fifth toe

convenient angle was refused by the parent It was hoped—if the parent had consented—to set the fifth toe into proper alignment with the rest of the foot A false forefoot of latex foam could have been built on, to which the sleeve of the fifth toe could have been anchored, and the whole of the appliance formed into the shape of a natural foot As the parent was not agreeable to radical treatment, it was decided to carry out this principle as far as possible, taking into account the angles of the fifth toe The moccasins were made with a firm texture of surgical sponge built up beneath the naviculars as a wedge,

FIG 118

The patient wearing the appliances



FIG 119

The patient wearing normal shoes with the moccasin appliances

to provide a level surface area for the feet and stabilise them in the correct position A sleeve for the fifth toe was included in both moccasins The sleeves were fixed to a false forefoot



FIG 123

Radiograph showing position of toes in the shoes Outline of the appliances can be clearly seen

of surgical sponge in such a way as to exert traction in an endeavour to bring the toes into more normal alignment

Surgical shoes were made to accommodate the child's feet wearing the appliances The child is at present wearing the shoes and appliances Whilst not actually painful, traction of the fifth toe right foot is giving a little trouble, but it is hoped that this will be overcome in due course (Figs 120, 121, 122, 123)



FIG. 121

Congenital deformity It will be seen that the hands have a similar defect to the feet Note the pressure areas beneath the central metatarsal area, right foot, and the fifth M P area, left foot

FIG 122

Casts and finished appliances

quickly justified the confidence and support so generously given by the hospital authorities

In the course of time some defects became apparent. Alterations in appliances necessitated a journey from the clinic to the processing laboratory, which was a considerable distance away, causing much delay in dealing with the numerous cases It was also not an ideal arrangement to carry out the plaster casting in the clinic which was used for treatment, but, nevertheless, the work of this new department flourished, and the gratitude of the patients and the enthusiastic support of the medical staff of the hospital more than compensated for any shortcomings in the facilities A time came, however, when the work of the department had outgrown the existing arrangements The experience gained in our somewhat modest beginning enabled us to design the new department on really sound lines

The new unit is self-contained, no longer involving crossing the hospital from one section to the other A common waiting-room serves both the chiropody clinic and the appliances section A chiropody clinic equal in size to the previous one provides the routine chiropody treatment A casting-room designed expressly for our particular type of work is situated between the consultant's room and the processing laboratory

It would be advantageous to describe the principal features of each room with the object of giving the reader a clear picture of the general organisation and administration of the unit

Waiting-room

This is a small room designed to accommodate about fourteen patients A large waiting-room is not necessary, as the appointment system operates A door leads from the waiting-room to the chiropody clinic

Chiropody Clinic

The clinic is equipped with the latest form of clinical furnishings, including three treatment chairs, instrument tables, foot lamps, nail drill, etc It is in this clinic that the

CHAPTER XIII

THE CHIROPODIAL ORTHOPÆDIC UNIT

IF it is agreed that the Chiropodial Orthopædic Unit should form part of the hospital orthopædic service, it would be profitable to consider how such a unit can be organised and how it should function as part of that service

It is not practicable for such a unit to be established at other than large hospitals, though it may be advisable to establish a department at one hospital to provide a service for a group, patients being referred to the chiropodial orthopædist in charge from the orthopædic departments of the various hospitals It is, however, the experience of the author that the value of such a service soon becomes apparent, and the demand upon it overwhelming

The equipment and the administration of the department can best be outlined by describing the layout and organisation of the unit established at Hope Hospital, Salford, which is the first of its kind

It was developed in progressive stages by the author and commenced as a small processing laboratory in addition to the usual chiropody clinic The laboratory was an L-shaped room with a casting bench lying along one wing and a metal-covered bench with built-in cupboards along the other A machine with scouring wheels, buffing wheels and brushes was installed for scouring, shaping and burnishing of the appliances A thermostatically controlled oven was also fitted as part of the processing equipment To assist in clearing the fumes and noxious vapours given off by certain of the processing materials an extraction fan was installed Casting was carried out in the chiropody clinic set aside for this work The appliances were also fitted in the chiropody clinic

This modest arrangement proved quite successful and

orthodox chiropody treatments are carried out and the foot appliances fitted (Fig 124)

The chiropody clinic is also used by the orthopædic surgeon when examining patients with a view to prescribing surgical footwear A short passage opens from this room into the plaster room

Plaster Room

A special feature of the plaster room is a platform, equal in height to the chiropodist's stool Upon this platform are placed the chairs for the patient This arrangement obviates the practitioner stooping to floor level when taking plaster casts He can sit in a comfortable position on the stool and place the patient's foot on the tray, which is at a convenient level A casting bench and sink are situated along the end of the room which is lighted by a large window (Figs 125, 126, 127)

Processing Laboratory

A door opening into a passage from the chiropody clinic to the plaster room gives entrance to the processing laboratory, which, like the plaster room, is lighted by a large window stretching almost across the whole width of the room The laboratory is equipped with a large table designed as a cutting-out table for leather and sheet rubber At one end of the table is situated the thermostatically-controlled oven This is useful for speeding up the curing process and drying out the leather and casts A shoemaker's finishing machine has been installed which provides all the necessary tools for grinding, scouring and polishing the appliances A special feature of the laboratory is a processing chamber which was designed by the author and keeps the noxious vapours and fumes from being inhaled by the chiropodist or technician Such substances as petroleum aether, cellulose cement, strong ammonia, etc, are used in the making of various types of appliances (Figs 128, 129)

The chamber has a sloping top fitted with windows of perspex The front of the chamber is fitted with canvas sleeves

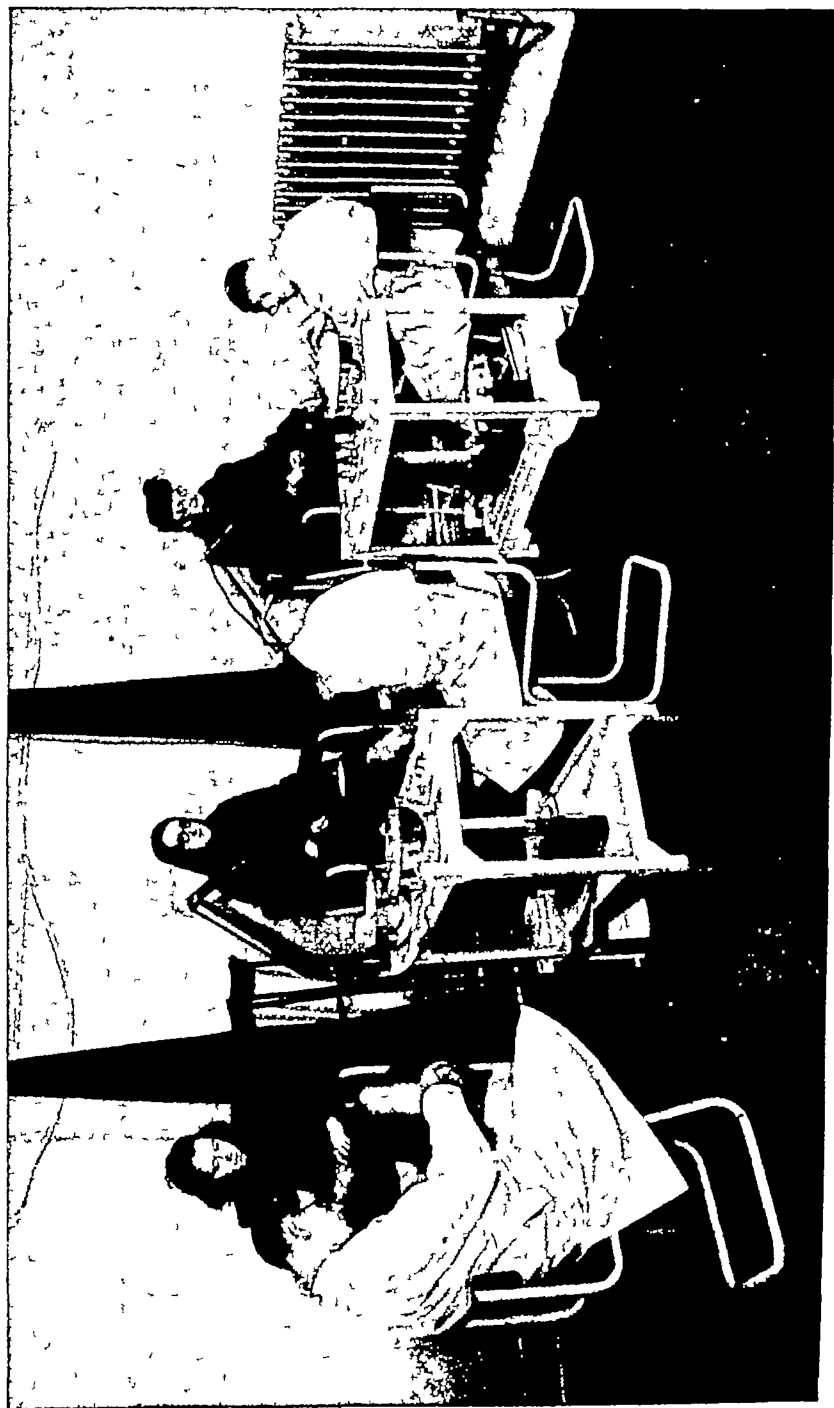


FIG 124

Chiropody clinic, for treatment and appliance fitting

and elastic wrist-bands At one end an aperture, covered with metal gauze, provides the air intake, whilst at the other end a funnel terminates in an extractor fan which draws the air with the noxious vapours from the chamber.

The various processes are carried out by passing the hands through the wrist-bands into the chamber which contains all



FIG 126

Casts of corrected and non-corrected foot, nearest and farthest from the camera, respectively

the necessary processing materials The work is observed through the roof of the chamber, which is fitted with windows This device has proved a great success Previous to the chamber being fitted, the room was always heavy with fumes, causing a headache, because an extractor fan fitted in the window was not successful in carrying off the fumes With the new chamber, the air in the room is fresh and quite free



FIG 125

Casting room, showing raised platform for convenience of operators

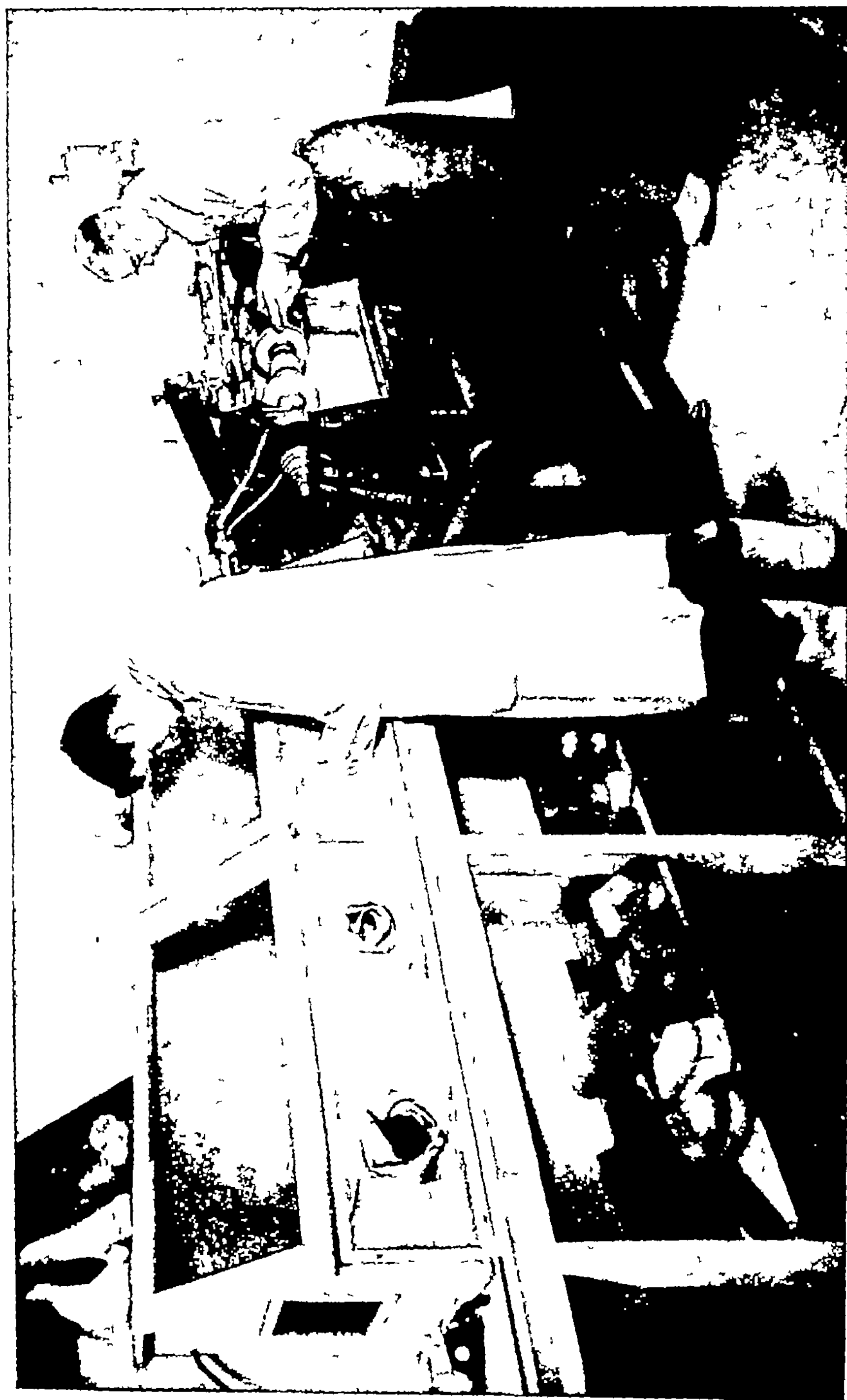


FIG 128

Processing laboratory, showing the special processing and drying chamber

from noxious vapours of any kind. The processing laboratory is also fitted with benches, sink and shelves, etc

Consultant's Office

The office, which has a separate entrance from the outside



FIG 127
Examining impressions of child's foot

of the building, can also be entered from the casting-room The office is used for consultation between the chiropodist and the orthopædic consultant, and for personal interviews with the patient when privacy is required The case sheets are filed in this office, and it is used by the appointments officer



FIG 130

Consultant's office, used for consultations and clinical records

when the clinics are in progress. A phone communicates with the exchange and all departments of the hospital (Fig 130)



FIG 129

The author demonstrating the rough trimming of a surgical insole to a student (Old Laboratory)

Record System

Patients for chiropody treatment must be referred either from their own doctor or from a department of the hospital, or another hospital or clinic A case sheet containing the full

appliances, which is filed in the processing laboratory and referred to when the appliances are being made All modification to the appliances are duly recorded on this card, also observation as to fit, comfort, etc

In cases of special interest, photographs are taken with the object of providing visual record of progress The records are invaluable for reference when undertaking treatment for cases of similar nature

Children's appliances are replaced every four to six months, according to age In the case of adults the patients are recalled at appropriate intervals for examination and, if found necessary, repair, alteration or replacement of appliances is carried out If new appliances are required, fresh impressions are taken every time It is felt that if the appliances have had any degree of success, the feet will have altered to some extent and, in consequence, accuracy in fit requires new casts

In conclusion, it should be mentioned that each patient is supplied with an appointment card, upon which is entered by the appointments clerk the date and time of the next visit

particulars of the patient and the history of the case is contained in a stiff folder, which is filed in the usual way Correspondence from the patient's doctor, hospitals, etc , is also placed in the

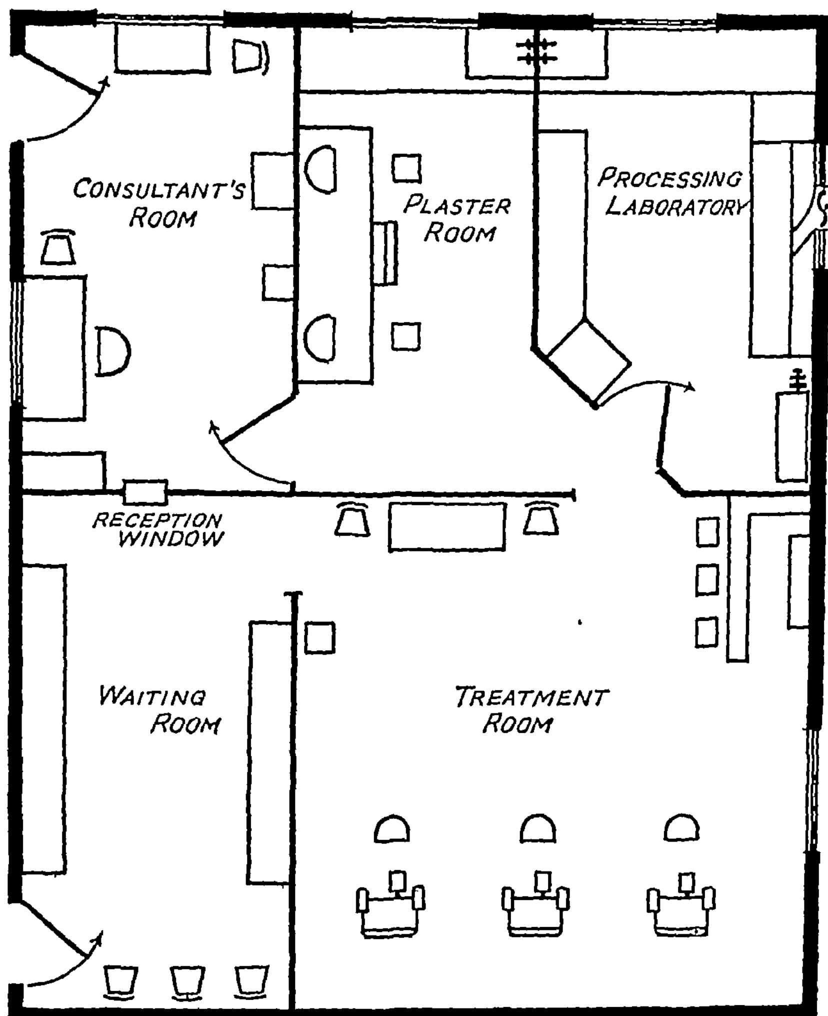


FIG 131
Plan of chiropodial orthopædic unit

folder for reference Every visit of the patient is recorded on the case sheet, with the date and treatment given, and any remarks of the chiropodist giving treatment

The cases referred for appliances have a special card, containing brief history of the case and full prescription for the

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